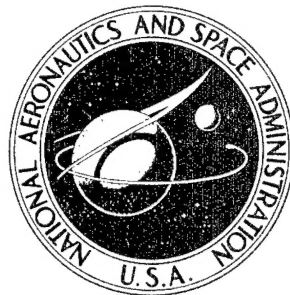


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NASA CR-1205(IV)

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COMPENDIUM OF HUMAN RESPONSES
TO THE AEROSPACE ENVIRONMENT

Volume IV

Conversion Tables

Alphabetic Index

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LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH

Albuquerque, N. Mex.

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • NOVEMBER 1968

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Edited by Emanuel M. Roth, M.D.

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Fred B. Benjamin, D.M.D., Ph. D.
NASA Project Manager

Prepared under Contract No. NASr-115 by
LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH
Albuquerque, N. Mex.

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GENERAL TABLE OF CONTENTS

VOLUME I

1. Microwave Radiation E. M. Roth
2. Light E. M. Roth, S. Finkelstein
3. Ionizing Radiation E. M. Roth
4. Magnetic Fields E. M. Roth
5. Electric Current S. Finkelstein, E. M. Roth
6. Thermal Environment T. A. Bottomley, E. M. Roth

VOLUME II

7. Acceleration E. M. Roth, W. G. Teichner, R. L. Craig
8. Vibration E. M. Roth, A. N. Chambers
9. Sound and Noise A. N. Chambers, E. M. Roth

VOLUME III

10. Oxygen--CO₂--Energy E. M. Roth
11. Inert Gas E. M. Roth
12. Pressure E. M. Roth
13. Contaminants E. M. Roth, W. G. Teichner, A. O. Mirarchi
14. Nutrition E. M. Roth
15. Water E. M. Roth
16. Anthropometry and Temporo-Spatial Environment E. M. Roth

VOLUME IV

- Conversion Tables
Alphabetic Index

CONVERSION TABLES

The multiple systems of units and measures used in the basic biological, physical, and engineering sciences is often confusing to those with interdisciplinary interests. The following tables have been selected from the Arnold Engineering Development Center Document AEDC TDR 62-6 as most pertinent to such interests. Tables of electrical and thermodynamic units not covered in this extract may be found in the AEDC document.

The reader may convert from the measure of quantities in the units listed on the left to those across the top of the page by multiplying by the given factor. The small number to the upper right of each factor is the power of ten by which the factor is to be multiplied. For example, 8.68977^{-2} is equivalent to 0.0868977. Underscores indicate exact values.

Slight numerical differences will be noticed between the values herein and those in most currently existing texts because of the redefinition of the foot in 1960.

The only exception to this approach is the altitude table, which is taken from the ARDC Model Atmosphere 1959.

TABLE 1

Length (l, d)

• A	miles (US)										miles (Nautical)	
	cm	ft	in.	km	m	μ	mils	mm	mm	mm	rods	yd
Angstrom Units	1.00000	$3.28084 \cdot 10^{-8}$	$3.93701 \cdot 10^{-9}$	$1.00000 \cdot 13$	$1.00000 \cdot 10$	$1.00000 \cdot 4$	$3.93701 \cdot 6$	$6.21371 \cdot 14$	$1.00000 \cdot 7$	$5.39957 \cdot 14$	$1.98839 \cdot 11$	$1.09361 \cdot 10$
Centimeters	1.00000^8	$3.28084 \cdot 2$	$3.93701 \cdot 1$	$1.00000 \cdot 5$	$1.00000 \cdot 2$	$1.00000 \cdot 4$	$3.93701 \cdot 2$	$6.21371 \cdot 6$	$1.00000 \cdot 1$	$5.39957 \cdot 6$	$1.98839 \cdot 3$	$1.09361 \cdot 2$
Feet	3.04800^9	1.00000	$1.20000 \cdot 1$	$3.04800 \cdot 4$	$3.04800 \cdot 1$	$3.04800 \cdot 5$	$1.20000 \cdot 4$	$1.89394 \cdot 4$	$3.04800 \cdot 2$	$1.64579 \cdot 4$	$6.06061 \cdot 2$	$3.33333 \cdot 1$
Inches	2.54000^8	$8.33333 \cdot 2$	1.00000	$2.54000 \cdot 5$	$2.54000 \cdot 2$	$2.54000 \cdot 4$	$1.00000 \cdot 3$	$1.57828 \cdot 5$	$2.54000 \cdot 1$	$1.37149 \cdot 5$	$5.05050 \cdot 3$	$2.77778 \cdot 2$
Kilometers	$1.00000 \cdot 13$	$3.28084 \cdot 3$	$3.93701 \cdot 4$	1.00000	$1.00000 \cdot 3$	$1.00000 \cdot 9$	$3.93701 \cdot 7$	$6.21371 \cdot 1$	$1.00000 \cdot 6$	$5.39957 \cdot 1$	$1.98839 \cdot 2$	$1.09361 \cdot 3$
Meters	$1.00000 \cdot 10$	3.28084	$3.93701 \cdot 1$	$1.00000 \cdot 3$	1.00000	$1.00000 \cdot 6$	$3.93701 \cdot 4$	$6.21371 \cdot 4$	$1.00000 \cdot 3$	$5.39957 \cdot 4$	$1.98839 \cdot 1$	1.09361
Microns	$1.00000 \cdot 4$	$3.28084 \cdot 6$	$3.93701 \cdot 5$	$1.00000 \cdot 9$	$1.00000 \cdot 6$	1.00000	$3.93701 \cdot 2$	$6.21371 \cdot 10$	$1.00000 \cdot 3$	$5.39957 \cdot 10$	$1.98839 \cdot 7$	$1.09361 \cdot 6$
Mils	$2.54000 \cdot 5$	$8.33333 \cdot 5$	$1.00000 \cdot 3$	$2.54000 \cdot 8$	$2.54000 \cdot 5$	$2.54000 \cdot 1$	1.00000	$1.57828 \cdot 8$	$2.54000 \cdot 2$	$1.37149 \cdot 8$	$5.05050 \cdot 6$	$2.77778 \cdot 5$
Miles (US)	$1.60934 \cdot 13$	$5.28000 \cdot 3$	$6.33600 \cdot 4$	1.60934	$1.60934 \cdot 3$	$1.60934 \cdot 9$	$6.33600 \cdot 7$	1.00000	$1.60934 \cdot 6$	$8.68977 \cdot 1$	$3.20000 \cdot 2$	$1.76000 \cdot 3$
Millimeters	$1.00000 \cdot 7$	$3.28084 \cdot 3$	$3.93701 \cdot 2$	$1.00000 \cdot 6$	$1.00000 \cdot 3$	$1.00000 \cdot 3$	$3.93701 \cdot 1$	$6.21371 \cdot 7$	1.00000	$5.39957 \cdot 7$	$1.98839 \cdot 4$	$1.09361 \cdot 3$
Miles (Nautical)	$1.85200 \cdot 13$	$6.07612 \cdot 3$	$7.29134 \cdot 4$	1.85200	$1.85200 \cdot 3$	$1.85200 \cdot 9$	$7.29134 \cdot 7$	1.15078	$1.85200 \cdot 6$	1.00000	$3.68250 \cdot 2$	$2.02537 \cdot 3$
Rods	$5.02920 \cdot 10$	$1.65000 \cdot 1$	$1.98000 \cdot 2$	$5.02920 \cdot 3$	5.02920	$5.02920 \cdot 6$	$1.98000 \cdot 5$	$3.12500 \cdot 3$	$5.02920 \cdot 3$	$2.71555 \cdot 3$	1.00000	5.00000
Yards	$9.14400 \cdot 9$	3.00000	$3.60000 \cdot 1$	$9.14400 \cdot 4$	$9.14400 \cdot 1$	$9.14400 \cdot 5$	$3.60000 \cdot 4$	$5.68182 \cdot 4$	$9.14400 \cdot 2$	$4.93737 \cdot 4$	$1.81818 \cdot 1$	1.00000

1. LENGTH

TABLE 2
Area (A)

	Acre	in. (Circular)	Mil (Circular)	cm ²	ft ²	in. ²	m ²	mm ²	Rod ²	Yard ²
Acre	<u>1.00000</u>	<u>7.98657</u> ⁶	<u>7.98657</u> ¹²	<u>4.04686</u> ⁷	<u>4.35600</u> ⁴	<u>6.27264</u> ⁶	<u>4.04686</u> ³	<u>4.04686</u> ⁹	<u>1.60000</u> ²	<u>4.84000</u> ³
Circular inch	<u>1.25211</u> ⁻⁷	<u>1.00000</u>	<u>1.00000</u> ⁶	<u>5.06707</u>	<u>5.45415</u> ⁻³	<u>7.85398</u> ⁻¹	<u>5.06707</u> ⁻⁴	<u>5.06707</u> ²	<u>2.00336</u> ⁻⁵	<u>6.06017</u> ⁻⁴
Circular mil	<u>1.25211</u> ⁻¹³	<u>1.00000</u> ⁻⁶	<u>1.00000</u>	<u>5.06707</u> ⁻⁶	<u>5.45415</u> ⁻⁹	<u>7.85398</u> ⁻⁷	<u>5.06707</u> ⁻¹⁰	<u>5.06707</u> ⁻⁴	<u>2.00336</u> ⁻¹¹	<u>6.06017</u> ⁻¹⁰
Centimeter ²	<u>2.47105</u> ⁻⁸	<u>1.97353</u> ⁻¹	<u>1.97353</u> ⁵	<u>1.00000</u>	<u>1.07639</u> ⁻³	<u>1.55000</u> ⁻¹	<u>1.00000</u> ⁻⁴	<u>1.00000</u> ²	<u>3.95368</u> ⁻⁶	<u>1.19598</u> ⁻⁴
Feet ²	<u>2.29568</u> ⁻⁵	<u>1.83347</u> ²	<u>1.83347</u> ⁸	<u>9.29030</u> ²	<u>1.00000</u>	<u>1.44000</u> ²	<u>9.29030</u> ⁻²	<u>9.29030</u> ⁴	<u>3.67310</u> ⁻³	<u>1.11111</u> ⁻¹
Inch ²	<u>1.59423</u> ⁻⁷	<u>1.27324</u>	<u>1.27324</u> ⁶	<u>6.45160</u>	<u>6.94444</u> ⁻³	<u>1.00000</u>	<u>6.45160</u> ⁻⁴	<u>6.45160</u> ²	<u>2.55076</u> ⁻⁵	<u>7.71605</u> ⁻⁴
Meter ²	<u>2.47105</u> ⁻⁴	<u>1.97353</u> ³	<u>1.97353</u> ⁹	<u>1.00000</u> ⁴	<u>1.07639</u> ¹	<u>1.55000</u> ³	<u>1.00000</u>	<u>1.00000</u> ⁶	<u>3.95368</u> ⁻²	<u>1.19598</u>
Millimeter ²	<u>2.47105</u> ⁻¹⁰	<u>1.97353</u> ⁻³	<u>1.97353</u> ³	<u>1.00000</u> ⁻²	<u>1.07639</u> ⁻⁵	<u>1.55000</u> ⁻³	<u>1.00000</u> ⁻⁶	<u>1.00000</u>	<u>3.95368</u> ⁻⁸	<u>1.19598</u> ⁻⁶
Rod ²	<u>6.25000</u> ⁻³	<u>4.99161</u> ⁴	<u>4.99161</u> ¹⁰	<u>2.52928</u> ⁵	<u>2.72250</u> ²	<u>3.92040</u> ⁴	<u>2.52928</u> ¹	<u>2.52928</u> ⁷	<u>1.00000</u>	<u>3.02500</u> ¹
Yard ²	<u>2.06611</u> ⁻⁴	<u>1.65012</u> ³	<u>1.65012</u> ⁹	<u>8.36127</u> ³	<u>9.00000</u>	<u>1.29600</u> ³	<u>8.36127</u> ⁻¹	<u>8.36127</u> ⁵	<u>3.30578</u> ⁻²	<u>1.00000</u>

2. AREA

TABLE 3

Volume (V)

	Centimeter ³	Feet ³	Gallon	Inch ³	Liter	Meter ³	Yard ³
Centimeter ³	<u>1.00000</u>	3.53146 ⁻⁵	2.64171 ⁻⁴	6.10236 ⁻²	9.99972 ⁻⁴	<u>1.00000</u> ⁻⁶	1.30794 ⁻⁶
Feet ³	2.83168 ⁴	<u>1.00000</u>	7.48052	<u>1.72800</u> ³	2.83161 ¹	2.83168 ⁻²	3.70370 ⁻²
Gallon (U.S.)	3.78543 ³	1.33680 ⁻¹	<u>1.00000</u>	<u>2.31000</u> ²	3.78533	3.78543 ⁻³	4.95113 ⁻³
Inch ³	1.63871 ¹	5.78704 ⁻⁴	4.32900 ⁻³	<u>1.00000</u>	1.63866 ⁻²	1.63871 ⁻⁵	2.14335 ⁻⁵
Liter	1.00003 ³	3.53156 ⁻²	2.64178 ⁻¹	6.10253 ¹	<u>1.00000</u>	1.00003 ⁻³	1.30798 ⁻³
Meter ³	<u>1.00000</u> ⁶	3.53146 ¹	2.64171 ²	6.10236 ⁴	9.99972 ²	<u>1.00000</u>	1.30794
Yard ³ (U.S.)	7.64554 ⁵	<u>2.70000</u> ¹	2.01974 ²	<u>4.66560</u> ⁴	7.64538 ²	7.64554 ⁻¹	<u>1.00000</u>

3. VOLUME

TABLE 4

Mass (m)

	Grain	Gram _m	Kilogram _m	Ounce (avdp)	Pound _{mass}	Slug	Ton (short)
Grain	<u>1.00000</u>	6.47988^{-2}	6.47988^{-5}	2.28571^{-3}	1.42857^{-4}	4.44012^{-6}	7.14285^{-8}
Gram _{mass}	1.54323^1	<u>1.00000</u>	<u>1.00000⁻³</u>	3.52739^{-2}	2.20462^{-3}	6.85216^{-5}	1.10231^{-6}
Kilogram _{mass}	1.54323^4	<u>1.00000³</u>	<u>1.00000</u>	3.52739^1	2.20462	6.85216^{-2}	1.10231^{-3}
Ounce (avdp)	<u>4.37500²</u>	2.83495^1	2.83495^{-2}	<u>1.00000</u>	6.25000^{-2}	1.94256^{-3}	3.12500^{-5}
Pound _{mass}	<u>7.00000³</u>	4.53592^2	4.53592^{-1}	<u>1.60000¹</u>	<u>1.00000</u>	3.10809^{-2}	<u>5.00000⁻⁴</u>
Slug	2.25218^5	1.45939^4	1.45939^1	5.14785^2	3.21740^1	<u>1.00000</u>	1.60870^{-2}
Ton (short)	<u>1.40000⁷</u>	9.07184^5	9.07184^2	<u>3.20000⁴</u>	<u>2.00000³</u>	6.21618^1	<u>1.00000</u>

4. MASS

TABLE 5
Time (t, r)

	Day	Hour	Microsecond	Millisecond	Minute	Second
Day	$\underline{1.00000}$	$\underline{2.40000}^1$	$\underline{8.64000}^{10}$	$\underline{8.64000}^7$	$\underline{1.44000}^3$	$\underline{8.64000}^4$
Hour	4.16666^{-2}	$\underline{1.00000}$	$\underline{3.60000}^9$	$\underline{3.60000}^6$	$\underline{6.00000}^1$	$\underline{3.60000}^3$
Microsecond	1.15741^{-11}	2.77778^{-10}	$\underline{1.00000}$	$\underline{1.00000}^{-3}$	1.66667^{-8}	$\underline{1.00000}^{-6}$
Millisecond	1.15741^{-8}	2.77778^{-7}	$\underline{1.00000}^3$	$\underline{1.00000}$	1.66667^{-5}	$\underline{1.00000}^{-3}$
Minute	6.94444^{-4}	1.66667^{-2}	$\underline{6.00000}^7$	$\underline{6.00000}^4$	$\underline{1.00000}$	$\underline{6.00000}^1$
Second	1.15741^{-5}	2.77778^{-4}	$\underline{1.00000}^6$	$\underline{1.00000}^3$	1.66666^{-2}	$\underline{1.00000}$

5. TIME

TABLE 6
Angle (α)

	Degree	Minute	Quadrant (right angle)	Radians	Revolutions	Seconds
Degree	<u>1.00000</u>	<u>6.00000¹</u>	<u>1.11111⁻²</u>	<u>1.74533⁻²</u>	<u>2.77778⁻³</u>	<u>3.60000³</u>
Minute	<u>1.66667⁻²</u>	<u>1.00000</u>	<u>1.85185⁻⁴</u>	<u>2.90889⁻⁴</u>	<u>4.62963⁻⁵</u>	<u>6.00000¹</u>
Quadrants (right angle)	<u>9.00000¹</u>	<u>5.40000³</u>	<u>1.00000</u>	<u>1.57080</u>	<u>2.50000⁻¹</u>	<u>3.24000⁵</u>
Radians	<u>5.72958¹</u>	<u>3.43775³</u>	<u>6.36620⁻¹</u>	<u>1.00000</u>	<u>1.59155⁻¹</u>	<u>2.06265⁵</u>
Revolutions	<u>3.60000²</u>	<u>2.16000⁴</u>	<u>4.00000</u>	<u>6.28320</u>	<u>1.00000</u>	<u>1.29600⁶</u>
Seconds	<u>2.77777⁻⁴</u>	<u>1.66667⁻²</u>	<u>3.08642⁻⁶</u>	<u>4.84815⁻⁶</u>	<u>7.71605⁻⁷</u>	<u>1.00000</u>

6. ANGLE

TABLE 7

Velocity (v)

	cm/sec	ft/min	ft/sec	Kilometer/hr	Knot	Meter/min	Meter/sec	Mile/hr
Centimeter/second	<u>1.00000</u>	1.96850	3.28084^{-2}	3.60000^{-2}	1.94384^{-2}	6.00000^{-1}	1.00000^{-2}	2.23694^{-2}
Feet/minute	5.08000^{-1}	<u>1.00000</u>	1.66667^{-2}	1.82880^{-2}	9.87473^{-3}	3.04800^{-1}	5.08000^{-3}	1.13636^{-2}
Feet/second	3.04800^1	<u>6.00000¹</u>	<u>1.00000</u>	<u>1.09728</u>	5.92484^{-1}	<u>1.82880¹</u>	3.04800^{-1}	6.81818^{-1}
Kilometer/hour	2.77778^1	5.46807^1	9.11344^{-1}	<u>1.00000</u>	5.39957^{-1}	1.66667^1	2.77778^{-1}	6.21371^{-1}
Knot*	5.14444^1	1.01268^2	1.68781	<u>1.85200</u>	<u>1.00000</u>	3.08667^1	5.14444^{-1}	1.15078
Meter/minute	1.66667	3.28084	5.46807^{-2}	6.00000^{-2}	3.23974^{-2}	<u>1.00000</u>	1.66667^{-2}	3.72823^{-2}
Meter/second	<u>1.00000²</u>	1.96850^2	3.28084	<u>3.60000</u>	1.94384	<u>6.00000¹</u>	<u>1.00000</u>	2.23694
Mile/hour	4.47040^1	8.80000^1	1.46667	1.60934	8.68976^{-1}	2.68224^1	4.47040^{-1}	<u>1.00000</u>

*One knot = one nautical mile per hour

7. VELOCITY

TABLE 8

Force (f)

	Dyne	Gram force	Kilogram force	Newton	Poundal	Pound force
Dyne	<u>1.00000</u>	1.01972^{-3}	1.01972^{-6}	<u>1.00000⁻⁵</u>	7.23301^{-5}	2.24809^{-6}
Gram force	<u>9.80665^2</u>	<u>1.00000</u>	<u>1.00000^{-3}</u>	<u>9.80665^{-3}</u>	7.09316^{-2}	2.20462^{-3}
Kilogram force	<u>9.80665^5</u>	<u>1.00000^3</u>	<u>1.00000</u>	9.80665	7.09316^1	2.20462
Newton	<u>1.00000^5</u>	1.01972^2	1.01972^{-1}	<u>1.00000</u>	7.23301	2.24809^{-1}
Poundal	1.38255^4	1.40981^1	1.40981^{-2}	1.38255^{-1}	<u>1.00000</u>	3.10809^{-2}
Pound force	<u>4.44822^5</u>	4.53594^2	4.53594^{-1}	4.44822	3.21740^1	<u>1.00000</u>

8. FORCE

TABLE 9

Pressure (p)

Standard Atmosphere	Bar**	Dynes/cm ² (Barye)	Feet Water at 60°F*	cm _{H₂O} /cm ²	Inches Hg at 32°F*	Inches Water at 60°F*	Kg _f /cm ²	lb _f /ft ²	lb _f /in. ²	Micron Hg at 32°F	mm Hg at 32°F*
Standard Atmosphere	1.01325	1.01325 ⁶	3.39320 ¹	1.03323 ³	2.99213 ¹	4.07184 ²	1.03323	2.11622 ³	1.46959 ¹	7.60000 ⁵	7.60000 ²
Bar**	9.86923 ⁻¹	1.00000 ⁶	3.34882 ¹	1.01972 ³	2.95300 ¹	4.01859 ²	1.01972	2.08854 ³	1.45038 ¹	7.50062 ⁵	7.50062 ²
Dynes/Centimeter ² (Barye)	9.86923 ⁻⁷	1.00000 ⁶	3.34882 ⁻⁵	1.01972 ⁻³	2.95300 ⁻⁵	4.01859 ⁻⁴	1.01972 ⁻⁶	2.08854 ⁻³	1.45038 ⁻⁵	7.50062 ⁻¹	7.50062 ⁻⁴
Feet Water (at 60°F)*	2.94707 ⁻²	2.98612 ⁻²	1.00000	3.04500 ¹	8.81801 ⁻¹	1.20000 ¹	3.04500 ⁻²	6.23664 ¹	4.33100 ⁻¹	2.23977 ⁴	2.23977 ¹
Gram _{Force} /Centimeter ²	9.67841 ⁻⁴	9.80665 ⁻⁴	3.28408 ⁻²	1.00000	2.89590 ⁻²	3.94089 ⁻¹	1.00000 ⁻³	2.04816	1.42233 ⁻²	7.35559 ²	7.35559 ⁻¹
Inches Mercury at 32°F*	3.34211 ⁻²	3.38639 ⁻²	1.13404	3.45315 ¹	1.00000	1.36085 ¹	3.45315 ⁻²	7.07262 ¹	4.91154 ⁻¹	2.54000 ⁴	2.54000 ¹
Inches Water at 60°F*	2.45589 ⁻³	2.48843 ⁻³	8.33333 ⁻²	2.53750	7.34834 ⁻²	1.00000	2.53750 ⁻³	5.19720	3.60917 ⁻²	1.86648 ³	1.86648
Kilogram _{Force} /Centimeter ²	9.67841 ⁻¹	9.80665 ⁻¹	3.28408 ¹	1.00000 ³	2.89590 ¹	3.94089 ²	1.00000	2.04816 ³	1.42233 ¹	7.35559 ⁵	7.35559 ²
Pound _{Force} /Foot ²	4.72541 ⁻⁴	4.78803 ⁻⁴	1.60343 ⁻²	4.88243 ⁻¹	1.41390 ⁻²	1.92411 ⁻¹	4.88243 ⁻⁴	1.00000	6.94444 ⁻³	3.59131 ²	3.59131 ⁻¹
Pound _{Force} /Inch ²	6.80460 ⁻²	6.89476 ⁻²	2.30894	7.03070 ¹	2.03602	2.77072 ¹	7.03070 ⁻²	1.44000 ²	1.00000	5.17149 ⁴	5.17149 ¹
Microns Mercury at 32°F*	1.31579 ⁻⁶	1.33322 ⁻⁶	4.46474 ⁻⁵	1.35951 ⁻³	3.93701 ⁻⁵	5.35768 ⁻⁴	1.35951 ⁻⁶	2.78450 ⁻³	1.93368 ⁻⁵	1.00000	1.00000 ⁻³
Millimeters Mercury at 32°F*	1.31579 ⁻³	1.33322 ⁻³	4.46474 ⁻²	1.35951	3.93701 ⁻²	5.35768 ⁻¹	1.35951 ⁻³	2.78450	1.93368 ⁻²	1.00000 ³	1.00000

*For g = 980.665 centimeters per second²

** Some writers erroneously use the term bar for barye.

9. PRESSURE

TABLE 10

Definitions:

$\frac{1 \text{ Btu}}{C_p \text{ lb}_m} = \frac{1 \text{ I.T. Cal}}{C_p \text{ gm}}$	$1 \text{ Btu}_{\text{mean}} = 1055.8 \text{ absolute joules}$	$1 \text{ Cal}_{\text{mean}} = 4.190 \text{ absolute joules}$
$1 \text{ I.T. Cal} = 1/860 \text{ int. watt hr}$	$1 \text{ Btu}_{\text{OF}} = 1060 \text{ absolute joules}$	$1 \text{ Cal}_{\text{20}} = 4.181 \text{ absolute joules}$
$1 \text{ int. watt} = 1.000165 \text{ ab. watt}$	$1 \text{ Btu}_{\text{60}} = 1054.6 \text{ absolute joules}$	$1 \text{ Thermochemical Calorie} = 4.1840 \text{ absolute joules}$
	$1 \text{ I.T. Btu} = 1055.04 \text{ absolute joules}$	$1 \text{ International Joule} = 1.000165 \text{ absolute joules}$
	$1 \text{ I.T. Cal}_{15} = 4.1854 \text{ absolute joules}$	$1 \text{ I.T. Calorie} = 1/860 \text{ international watt hour}$
	$1 \text{ I.T. Calorie} = 4.18674 \text{ absolute joules}$	$1 \text{ Kilocalorie or large calorie} = 1000 \text{ calories}$

10. ENERGY

TABLE 11

Power (P)

	Btu/hr	Btu/min	Btu/sec	I.T.Cal/hr	I.T.Cal/min	I.T.Cal/sec	erg/sec	ft.-lb. _p /min	ft.-lb. _p /sec	hp (Elec)	hp (Mech)	hp (Metric)	kg _m /sec	kV	V
Btu/hr	1.00000	1.66667 ⁻²	2.77778 ⁻⁴	2.51996 ²	4.19993	6.99988 ⁻²	2.93067 ⁶	1.29693 ¹	2.16155 ⁻¹	3.9851 ⁻⁴	3.93009 ⁻⁴	3.98460 ⁻⁴	2.98845 ⁻²	2.93067 ⁻⁴	2.93067 ⁻¹
Btu/min	6.00000 ¹	1.00000	1.66667 ⁻²	1.51197 ⁴	2.51996 ²	4.19993	1.75840 ⁸	7.78158 ²	1.29693 ¹	2.35711 ⁻²	2.35805 ⁻²	2.39076 ⁻²	1.79307	1.75840 ⁻²	1.75840 ¹
Btu/sec	3.60000 ³	6.0000 ¹	1.00000	9.07183 ⁵	1.51197 ⁴	2.51996 ²	1.05504 ¹⁰	4.66944 ⁴	7.78158 ²	1.41426	1.41483	1.43446	1.07584 ²	1.05504	1.05504 ³
I.T.Cal/hr	3.96832 ⁻³	6.61387 ⁻⁵	1.10231 ⁻⁶	1.00000	1.66667 ⁻²	2.77778 ⁻⁴	1.16298 ⁴	5.14663 ⁻²	8.57772 ⁻⁴	1.55896 ⁻⁶	1.55958 ⁻⁶	1.58122 ⁻⁶	1.18591 ⁻⁴	1.16298 ⁻⁶	1.16298 ⁻³
I.T.Cal/min	2.38099 ⁻¹	3.96832 ⁻³	6.61387 ⁻⁵	6.00000 ¹	1.00000	1.66667 ⁻²	6.97790 ⁵	3.08798	5.14663 ⁻²	9.35376 ⁻⁵	9.35751 ⁻⁵	9.48730 ⁻⁵	7.11547 ⁻³	6.97790 ⁻⁵	6.97790 ⁻²
I.T.Cal/sec	1.42859 ¹	2.38100 ⁻¹	3.96832 ⁻³	3.60000 ³	6.00000 ¹	1.00000	4.18674 ⁷	1.85279 ²	3.08798	5.61225 ⁻³	5.61451 ⁻³	5.69238 ⁻³	4.26928 ⁻¹	4.18674 ⁻³	4.18674
erg/sec	3.41219 ⁻⁷	5.68699 ⁻⁹	9.47831 ⁻¹¹	8.59858 ⁻⁵	1.43310 ⁻⁶	2.38849 ⁻⁸	1.00000	4.42537 ⁻⁶	7.37562 ⁻⁸	1.34048 ⁻¹⁰	1.34102 ⁻¹⁰	1.35962 ⁻¹⁰	1.01972 ⁻⁸	1.00000 ⁻¹⁰	1.00000 ⁻⁷
ft.-lb. _p /min	7.71052 ⁻²	1.28509 ⁻³	2.14181 ⁻⁵	1.94302 ¹	3.23836 ⁻¹	5.39727 ⁻³	2.25970 ⁵	1.00000	1.66667 ⁻²	3.02909 ⁻⁵	3.03030 ⁻⁵	3.07233 ⁻⁵	2.30425 ⁻³	2.25970 ⁻⁵	2.25970 ⁻²
ft.-lb. _p /sec	4.68631	7.71052 ⁻²	1.28509 ⁻³	1.16581 ³	1.94302 ¹	3.23836 ⁻¹	1.35582 ⁷	6.00000 ¹	1.00000	1.81745 ⁻³	1.81818 ⁻³	1.84340 ⁻³	1.38255 ⁻¹	1.35582 ⁻³	1.35582
hp (Elec)	2.54549 ³	4.24079 ¹	7.07081 ⁻¹	6.41453 ⁵	1.06909 ⁴	1.78182 ²	7.46000 ⁹	3.30132 ⁴	5.50221 ²	1.00000	1.00040	1.01427	7.60707 ¹	7.46000 ⁻¹	7.46000 ²
hp (Mech)	2.54447 ³	4.24079 ¹	7.06798 ⁻¹	6.41196 ⁵	1.06866 ⁴	1.78110 ²	7.45701 ⁹	3.30000 ⁴	5.50000 ²	9.95599 ⁻¹	1.00000	1.01387	7.60402 ¹	7.45701 ⁻¹	7.45701 ²
hp (Metric)	2.50966 ³	4.18277 ¹	6.97129 ⁻¹	6.32424 ⁵	1.05404 ⁴	1.75673 ²	7.35500 ⁹	3.25486 ⁴	5.42476 ²	9.85924 ⁻¹	9.86320 ⁻¹	1.00000	7.50000 ¹	7.35500 ⁻¹	7.35500 ²
kg _m /sec	3.34622 ¹	5.57703 ⁻¹	9.29505 ⁻³	8.43233 ³	1.40539 ²	2.34231	9.80665 ⁷	4.33981 ²	7.23301	1.31456 ⁻²	1.31509 ⁻²	1.33333 ⁻²	1.00000	9.80665 ⁻³	9.80665
kilowatt	3.41219 ³	5.68699 ¹	9.47831 ⁻¹	8.59858 ⁵	1.43310 ⁴	2.38849 ²	1.00000 ¹⁰	4.42537 ⁴	7.37562 ²	1.34048	1.34102	1.35962	1.01972 ²	1.00000	1.00000 ³
watt	3.41219	5.68699 ⁻²	9.47831 ⁻⁴	8.59858 ²	1.43310 ¹	2.38849 ⁻¹	1.00000 ⁷	4.42537 ¹	7.37562 ⁻¹	1.34048 ⁻³	1.34102 ⁻³	1.35962 ⁻³	1.01972 ⁻¹	1.00000 ⁻³	1.00000

11. POWER

TABLE 14

Temperature* (T, θ)

To convert from the units below to those on the right, perform the indicated operations in order.	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{K}$	$^{\circ}\text{R}$
	$x 1$	$x 9/5 + 32$	$+ 273.15$	$x 9/5 + 491.67$
$^{\circ}\text{C}$	$- 32 x 5/9$	$x 1$	$x 5/9 + 255.372$	$+ 459.67$
$^{\circ}\text{F}$	$- 273.15$	$x 9/5 - 459.67$	$x 1$	$x 9/5$
$^{\circ}\text{K}$	$x 5/9 - 273.15$	$- 459.67$	$x 5/9$	$x 1$
$^{\circ}\text{R}$				

*Based on the thermodynamic temperature scale as defined by the Tenth General Conference on Weights and Measure meeting at Paris in October 1954.

Temperature of triple point of water = $273.16^{\circ}\text{K} = 491.688^{\circ}\text{R} = 32.018^{\circ}\text{F} = 0.01^{\circ}\text{C}$

Temperature of ice point of water = $273.15^{\circ}\text{K} = 491.67^{\circ}\text{R} = 0^{\circ}\text{C} = 32^{\circ}\text{F}$

14. TEMPERATURE

TABLE 15

Altitude (A)

Altitude (feet)	Temperature °F.	Pressure	
		mm. Hg.	p.s.i.
0	59.000	759.99	14.696
500	57.217	746.76	14.440
1000	55.434	733.53	14.184
1500	53.652	720.27	13.928
2000	51.869	707.03	13.672
2500	50.086	693.80	13.416
3000	48.304	681.51	13.178
3500	46.521	669.24	12.941
4000	44.739	656.95	12.703
4500	42.956	644.68	12.466
5000	41.174	632.38	12.228
5500	39.392	621.00	12.008
6000	37.610	609.63	11.788
6500	35.827	598.22	11.568
7000	34.045	586.84	11.348
7500	32.263	575.46	11.128
8000	30.481	564.92	10.924
8500	28.700	554.38	10.720
9000	26.918	543.84	10.516
9500	25.137	533.30	10.312
10000	23.355	522.75	10.108
10500	21.574	513.00	9.9200
11000	19.793	503.28	9.7318
11500	18.012	493.52	9.5432
12000	16.231	483.79	9.3551
12500	14.450	474.04	9.1665
13000	12.669	465.05	8.9926
13500	10.888	456.06	8.8188
14000	9.108	447.07	8.6449
14500	7.327	438.07	8.4710
15000	5.546	429.08	8.2972

TABLE 15
(continued)

Altitude (feet)	Temperature °F.	Pressure	
		mm. Hg.	p.s.i.
15500	3.766	420.80	8.1370
16000	1.985	412.52	7.9769
16500	0.205	404.22	7.8163
17000	- 1.576	395.94	7.6562
17500	- 3.356	387.65	7.4961
18000	- 5.136	380.03	7.3487
18500	- 6.916	372.41	7.2014
19000	- 8.695	364.77	7.0535
19500	-10.475	357.15	6.9062
20000	-12.255	349.53	6.7589
21000	-15.814	335.51	6.4877
22000	-19.373	321.51	6.2171
23000	-22.931	308.08	5.9573
24000	-26.489	295.25	5.7092
25000	-30.047	282.40	5.4607
26000	-33.604	270.64	5.2333
27000	-37.161	258.88	5.0059
28000	-40.718	247.62	4.7883
29000	-44.275	236.88	4.5805
30000	-47.831	226.13	4.3727
31000	-51.387	216.33	4.1832
32000	-54.942	206.53	3.9937
33000	-58.497	197.17	3.8127
34000	-62.052	188.25	3.6402
35000	-65.607	179.33	3.4677
36000	-67.244	171.25	3.3115
37000	-68.881	163.18	3.1554
38000	---	155.55	3.0078
39000	---	148.37	2.8690
40000	-69.700	141.18	2.7301

TABLE 15
(continued)

Altitude (feet)	Temperature °F.	Pressure	
		mm. Hg.	p.s.i.
41000	---	134.81	2.6069
42000	---	128.44	2.4837
43000	---	122.43	2.3675
44000	---	116.78	2.2582
45000	-69.700	111.13	2.1490
46000	---	106.12	2.0520
47000	---	101.11	1.9552
48000	---	96.380	1.8637
49000	---	91.933	1.7777
50000	-69.700	87.488	1.6918
51000	---	83.543	1.6155
52000	---	79.599	1.5392
53000	---	75.877	1.4672
54000	---	72.380	1.3996
55000	-69.700	68.882	1.3320
56000	---	65.778	1.2720
57000	---	62.674	1.2119
58000	---	59.746	1.1553
59000	---	56.993	1.1021
60000	-69.700	54.239	1.0488
61000	---	51.069	9.8753×10^{-1}
62000	---	47.902	9.2628
63000	---	44.732	8.6498
64000	---	41.562	8.0368
65000	---	38.395	7.4244
70000	-69.700	33.640	6.5049
80000	-69.700	20.874	4.0365
90000	-57.204	13.033	2.5202
100000	-40.893	8.2906	1.6031
150000	40.425	1.0988	2.1248×10^{-2}
200000	- 10.69	1.6934	3.2744×10^{-3}
300000	-160.5	7.605×10^{-4}	1.471×10^{-5}
400000	464.2	1.351×10^{-5}	2.612×10^{-7}
500000	1473	3.721×10^{-6}	7.195×10^{-8}
1000000	2104	1.777×10^{-7}	3.437×10^{-9}
2000000	2604	3.612×10^{-9}	6.984×10^{-11}

AEROSPACE ENVIRONMENTS

1. Microwave Radiation
2. Light
3. Ionizing Radiation
4. Magnetic Fields
5. Electric Current
6. Thermal Environment
7. Acceleration
8. Vibration
9. Sound and Noise
10. Oxygen-CO₂-Energy
11. Inert Gas
12. Pressure
13. Contaminants
14. Nutiriton
15. Water
16. Anthropometry and
Temporo-spatial
Environment

ALPHABETIC INDEX

A

$\pm A_x$	F. or T. 7-1, 34, 37
$\pm A_y$	F. or T. 7-1, 37
$\pm A_z$	F. or T. 7-1, 34, 37
Abbott's method	3-52
Abdomen.	6-73
	F. or T. 6-22, 26 to 29, 54
	7-17
	8-16, 17, 19, 34, 44 to 46, 79
	F. or T. 8-3, 12, 13, 20 to
	23, 25
	9-9
	F. or T. 9-4, 36
	F. or T. 16-9
Abdominal viscera	12-40
Abduction	F. or T. 16-12, 18, 19, 23
Aberration, perceptual	16-70
Abort level	F. or T. 13-16
Abort mode	7-56
Abrasion	7-215
	F. or T. 7-94
	8-45
	16-54 to 65, 69
Abrupt acceleration.	See also Impact
	7-4
Absorbitivity, thermal.	F. or T. 6-14, 78
Absorption.	See also Attenuation, sound
	2-110 to 120
	F. or T. 2-77 to 82
	9-56 to 58, 82
Absorption, physiological	10-11
Absorption coefficient.	1-1, 2, 12
	F. or T. 1-5
Acanthosis.	2-68
Acceleration (G)	2-68, 72
	3-80
	F. or T. 3-65
	6-9
	F. or T. 6-4
	7-1 to 221
	F. or T. 7-1 to 94
	10-49, 53
	F. or T. 10-37 to 39
	14-14
	F. or T. 14-7
	16-1, 3, 16, 43, 49, 65

NOTE:

Following each subject is the number for the environmental section (see preceding page) and the table number in that section. Figures or Tables are given as F or T followed by chapter and page number.

Acceleration, linear (sustained) See also specific G
8-1, 2, 5, 8, 13, 89 to 91
F. or T. 8-11

Acceleration, maximum See Peak acceleration

Acceleration tolerance 15-12

Accelerometer F. or T. 7-84
8-8, 23
F. or T. 8-16

Accident F. or T. 6-83

Accidental fall 7-190, 205
F. or T. 7-65, 77, 84

Acclimatization See also Training
6-33, 70, 103 to 106, 113, 125,
126, 127
F. or T. 6-4, 59, 60, 68, 75,
80, 92, 93, 112, 113
10-22 to 25, 48, 63
F. or T. 10-18
12-1, 2
13-17
15-12

Accommodation, visual 2-93, 108
F. or T. 10-36

Accumulation rate factor (RF_A) 3-65, 66
F. or T. 3-53

Acetone See Ketone bodies

ACGIH 13-1
F. or T. 13-16

Acid F. or T. 13-15 to 18

Acid, organic F. or T. 13-3, 7, 8, 14 to 18

Acidosis 14-38

Acidosis, respiratory 10-72 to 76
F. or T. 10-50

Acoustic (auditory) effects 8-2, 7, 8, 32 to 34, 46
F. or T. 8-3, 19, 27, 39

Acoustic environment 9-1, 5 to 11
F. or T. 9-3 to 5

Acoustic impedance F. or T. 7-74
11-1

Acquisition light See Signal light

Acquisition phase 2-97 to 101
F. or T. 2-72 to 74

Acrolein 13-26
F. or T. 13-15 to 18, 24

Action spectrum, chemical 2-114
F. or T. 2-79

Activation curve 16-82

Activity See Exercise and Work

Acuity, visual 8-67 to 77, 83, 85, 86, 88, 91
F. or T. 8-31, 40 to 43, 51
9-53 to 55 (cont)

Acuity, visual (cont). F. or T. 9-36
10-69, 70
F. or T. 10-36, 38, 47
F. or T. 11-8

Acute exposure. See also Duration and Dose
rate
13-80
F. or T. 13-19

Adaptation See also Habituation and
Acclimatization
7-39, 74, 93, 96, 100, 102,
104, 106, 118, 119
F. or T. 7-61
9-41, 48, 49
13-91
16-81, 82, 84, 87 to 92, 95,
96
F. or T. 16-30

Adaptation brightness See Pre-exposure light

Additive toxicity. 13-13

Adduction F. or T. 16-12, 18, 19, 23

ADH. See Antidiuresis (hormone)

Adiabatic bulk modulus 11-3

Adiabatic expansion 12-25, 26
F. or T. 12-18

Adjustable couch See also Couch
8-40 to 46, 75, 92 to 94
F. or T. 8-24, 25

Adrenal (hormones) See also Cortisone
1-8
10-71, 73
F. or T. 11-8
15-9
16-94

Adsorption (beds) 13-5 to 8
F. or T. 13-2

Aerobacter 15-20

Aerobes 13-92

Aerodynamic 8-1
13-85 to 91
F. or T. 13-22, 23

Aerosol See also specific type
13-85 to 91
F. or T. 13-22, 23

Aerotitis media F. or T. 11-8, 16

African native F. or T. 6-60, 92

Afterburner F. or T. 9-5

Afterimage 2-58, 60, 65
F. or T. 7-63

Agar. F. or T. 11-2

Age F. or T. 2-38 (cont)

Age (cont) 3-77, 80, 89
7-5
9-42, 59, 81
F. or T. 9-34
10-18, 19
F. or T. 10-2, 4
12-6, 7
F. or T. 12-3, 5
13-12, 14
F. or T. 14-1
16-3
F. or T. 16-6, 10, 12, 15, 17
2-104
Agena See also Chemical and Contam-
Agent inant trace
F. or T. 13-15 to 18
Aging, premature See Life-shortening
Aggression 16-77 to 79
Aiming F. or T. 8-39
6-70, 81
Air F. or T. 6-3, 10, 13, 14, 21
35, 36, 37, 44, 57
8-1, 17, 33
F. or T. 8-12
9-2, 3
10-46, 48
F. or T. 10-34, 38, 39
11-3
F. or T. 11-4
12-7, 15, 16, 40, 41
F. or T. 12-5 to 7, 11
13-11
F. or T. 15-6
13-91
Air conditioning F. or T. 13-25
Air dose See also Dose, surface
3-1, 57
F. or T. 3-45
Air flow See also Aerodynamic and
Velocity, gas
12-11 to 30
F. or T. 12-9 to 19
F. or T. 6-105
Air Force See Night glow
Air glow See also Motion sickness
Air sickness 7-82 to 85
7-16
Air temperature 3-52, 80
Aircraft 7-56, 67, 85 to 96, 197
F. or T. 7-1, 68, 69
8-35, 51 (cont)

Aircraft (cont)	F. or T. 8-22, 30 to 33, 37, 50 9-14, 17, 30, 56, 76 to 82 F. or T. 9-3, 10, 37, 50 10-6 F. or T. 13-21, 25 16-3, 43, 92 F. or T. 16-2, 17, 25
Airline, commercial	8-56 F. or T. 8-31, 34, 37
Airlock	12-14, 15 16-36, 37
Alaska	F. or T. 6-102, 105
Albedo	F. or T. 2-6 6-9
Alcohol	F. or T. 6-91 F. or T. 13-15 to 18
Aldehyde	F. or T. 13-15 to 18
Aldosterone	7-116, 126 15-9
Alert level	13-79 F. or T. 13-16
Alertness	F. or T. 7-39, 56, 57 9-49 to 51 10-69, 70, 75 F. or T. 10-40, 47 16-81, 83 to 87, 89 to 92
Algae, regenerative systems	14-3
Aliphatic hydrocarbons	13-26 to 80 F. or T. 13-15 to 18
Alkali (Earth) compounds	10-42 to 45 F. or T. 10-33
Alpha adaptation	2-92
Alpha blocking	9-48
Alpha-numeric symbols	2-42, 60, 61, 85, 86 F. or T. 2-52, 60 to 65
Alpha particles	3-1, 18, 26 to 32, 38, 39, 44, 48, 49, 53, 59, 77, 88 F. or T. 3-4, 13, 16 to 19, 21, 27, 29, 31, 35
Alpha rhythms	16-78, 93
Altitude	See also Barometric pressure and Pressure, static 2-105 to 108 F. or T. 2-7, 60, 72 3-44 F. or T. 6-77 F. or T. 7-15, 107, 138 8-48, 56 9-5, 10, 31 F. or T. 9-28, 32, 37 (cont)

Altitude (cont) F. or T. 10-34, 35, 36, 38,
39, 46
12-2 to 41
F. or T. 12-1, 2, 5, 11, 16

Aluminized surface and insulation. 6-53, 56
F. or T. 6-44, 97
12-12

Aluminum 3-18, 45
F. or T. 3-15, 34
14-32

Aluminum foil F. or T. 7-13

Alveolar ventilation See also Lung

Alveoli. 10-46, 48, 53, 63, 71 to 76
F. or T. 10-34, 47, 48, 50
12-2, 26, 28, 31, 35

American Standards Association 13-1
F. or T. 13-3
7-35, 49

Ames restraint system F. or T. 13-15 to 18

Amides F. or T. 13-15 to 18

Amines F. or T. 13-3, 4, 7, 8, 10, 13

Amino acid 3-82

Aminothiols F. or T. 13-15 to 19

Ammonia. 7-90

Amphetamine 9-36 to 39

Amplifier See also Intensity

Amplitude 2-105
7-38, 83
F. or T. 7-50
8-2, 3, 6, 8 to 94
F. or T. 8-1 to 51
9-1, 2
F. or T. 9-1

AMU 7-125, 143 to 147
F. or T. 7-66
12-12
16-16

Anaerobic microbes 13-92
15-20, 21

Anaerobic work 14-35, 36, 38

Analgesia, sound 9-51

Analytic devices and processes 13-79, 85

Anatomy, ear. 9-3
F. or T. 9-2

Anchor, tetherline 7-163 to 165
F. or T. 7-67

Anemia See also Red blood cell
3-53
10-55

Anesthesia (anesthetics) 8-19
F. or T. 13-15
16-96

Angle See also Back angle and Motion
and Mobility and Forces and
Joints
7-5, 38, 46, 106
F. or T. 7-69, 86 to 88
F. or T. 8-24, 25

Angle, directional. See also Visual angle
2-8, 52, 53, 78, 93, 94, 99,
100
F. or T. 2-2, 61

Angle of emission. 3-18

Angular acceleration See also Rotation
7-4, 62 to 110
F. or T. 7-35 to 63, 65, 67
16-3, 16
F. or T. 16-6

Angular oscillation F. or T. 7-42
8-60

Angular rate perception 2-42, 93 to 95, 98 to 108
F. or T. 2-39, 72 to 76

Angular velocity 7-4, 67, 76 to 82, 91, 93, 94,
95, 97 to 110, 127, 157 to
165, 179 to 182
F. or T. 7-38, 41, 47 to 52,
58 to 61, 65, 67

Animal. See also specific type
1-7, 8, 9
3-48 to 51, 63, 69, 70, 73,
77, 78, 79, 81, 83
F. or T. 3-38
4-1
5-15, 16, 19
F. or T. 5-7
F. or T. 7-63
8-8, 17, 19, 34, 35, 48
9-47, 48, 51, 56, 57
12-22, 23, 31, 32, 34
F. or T. 12-21
13-1 to 4, 12, 14 to 16, 82, 92
F. or T. 13-15, 20

Ankle 7-49
F. or T. 7-91
8-11
F. or T. 16-4, 5, 11, 12, 19,
23

Annoyance See also Discomfort
F. or T. 8-31, 35
9-41, 56
F. or T. 9-26
13-10

Anorexia. See Appetite

Anoxemia. See Hypoxia
 Anoxia See Hypoxia
 Antagonism, toxic 13-13
 Anterior chamber 2-1
 Anterior horn cells 5-13
 Anthropometry 16-1 to 64
 F. or T. 16-1 to 22
 Anti-G device. See also G suit and specific
 device
 F. or T. 7-18
 Antibodies 13-14
 Antidiuresis (hormone). See also ADH
 7-116
 F. or T. 7-57
 10-66, 67
 Antimicrobial agents 3-82
 Antinausea and vomiting drugs See Antinauseants
 Antinauseants. 3-51, 82
 Antioxidants 13-16
 Antiradiation (radioprotective) agents 3-81, 82
 Anxiety. F. or T. 6-4
 7-5, 46, 82, 90, 126
 F. or T. 7-65
 12-4
 14-8
 Aorta (arch) 7-57, 199, 213
 Aortic bodies 10-24
 Aortic retinal angle or plane 7-40
 F. or T. 7-2
 Aperiodic noise See Random noise
 Aperiodic vibration See Random vibration
 Apogee. 3-45
 Apollo 2-80 to 87
 F. or T. 2-62
 3-33
 F. or T. 3-27
 6-52, 56, 62, 64 to 66, 68
 F. or T. 6-52 to 54
 7-6, 21, 40, 183, 187, 205,
 209, 211, 221
 F. or T. 7-2, 73, 87, 88
 9-7 to 10, 39, 77, 79 to 82
 F. or T. 9-3, 4
 10-30 to 46, 65
 F. or T. 10-21 to 32
 11-39
 14-1, 18, 24, 29
 F. or T. 14-14
 15-5
 F. or T. 15-6
 16-26, 48 to 64
 F. or T. 16-18 to 24

Apollo Applications Program (AAP) 3-85
 Apostilbs F. or T. 2-4, 5
 Appetite See also Intake, food
 3-49 to 51
 F. or T. 3-36, 42
 7-131
 10-75
 14-9
 F. or T. 15-9
 Apprehension (anxiety) 8-36, 48
 F. or T. 8-20
 Aqueous 2-1
 12-30
 Arc welding 2-116
 Arctic and Antarctic 6-12, 125
 F. or T. 6-95, 102, 109
 10-17
 F. or T. 10-5, 9
 14-38
 16-75
 Arctic exposure suit 6-121
 Area See also Area, body surface
 2-20
 F. or T. 2-22, 43
 3-6, 58, 60, 61, 72, 73, 77
 F. or T. 3-45 to 47, 51
 6-12, 20 to 25, 49, 59, 73,
 91, 112, 113
 F. or T. 6-1, 4, 16, 17, 18,
 22, 29, 54, 57, 64, 102,
 103
 7-168, 215
 13-5, 6
 16-21, 26
 F. or T. 16-10
 Area, body surface 10-5
 F. or T. 10-3
 15-7
 16-26
 Area effectiveness factor F. or T. 3-47, 76
 Area, hole or orifice 12-12 to 31
 F. or T. 12-9, 12 to 19
 Argon 3-18
 F. or T. 3-15
 F. or T. 11-1, 2, 4, 5
 12-2
 F. or T. 12-18, 21
 Arithmetic F. or T. 6-88
 7-49, 106
 16-94
 Arm 5-9
 6-57, 73 (cont)

Arm (cont)	F. or T. 6-22, 26 to 29, 45, 54, 57, 94, 105 7-35, 48, 94, 123, 133 to 168, 181 to 183 F. or T. 7-66, 78, 86, 91 8-2, 5, 79 to 94 F. or T. 8-15 10-25 to 30 F. or T. 10-20, 21, 26 F. or T. 13-9, 12
Arm (spread and reach)	16-49, 55, 62, 64 F. or T. 16-2 to 6, 8 to 15, 19, 23
Army	6-116, 125 F. or T. 6-90, 92, 93, 106 F. or T. 16-9
Aromatic hydrocarbons	13-26 to 80 F. or T. 13-15 to 18
Arousal	F. or T. 7-56 8-46 9-48 16-83 to 85, 96
Arrhythmias, cardia	1-11 9-49 10-70 F. or T. 11-8 12-4, 32, 33, 34
Arterial oxygen	10-23, 24, 48, 49, 72, 73 F. or T. 10-35 to 39, 50
Arterial pressure	See Blood pressure
Arteries	See also specific type 7-57 F. or T. 7-18, 32 8-32, 35, 48
Arteriole	2-111
Arteriovenous (A-V) difference	F. or T. 7-32
Arteriovenous shunts (pulmonary)	10-24
Articulation index	9-3, 24 to 30, 39 F. or T. 9-18 to 25, 29, 31
Artificial electron belt	3-45
Artificial respiration	5-20
Asbestos	F. or T. 6-95
Ascorbic acid	See Vitamin C
Ash	F. or T. 14-9, 11, 13
Asphyxiant	13-10 F. or T. 13-15, 18
Asphyxiation	5-9, 10 F. or T. 5-3, 4
Assembly	16-47
Asthenia	1-11, 15

Astronaut. See also Pilot and Cosmonaut
 3-44, 45, 63 to 69, 74, 77 to
 80, 82, 84 to 89
 6-3, 4, 127
 7-17, 96, 127 to 164
 8-78
 9-1, 5, 7, 21, 42, 81, 82
 F. or T. 9-3, 4, 26
 10-6, 7, 18, 19, 23 to 25, 45,
 55, 63, 65 to 67, 70, 71
 F. or T. 10-41
 12-7, 10 to 12, 29
 13-11, 88, 91, 92
 14-1, 9, 18 to 23, 42
 F. or T. 14-9
 15-5, 9
 16-1, 3, 26, 48 to 65, 79,
 81 to 85
 F. or T. 16-4, 18 to 22
 Astronaut Maneuvering Unit See AMU
 Astronomical constants and phenomena 2-8, 56, 57, 81, 82, 92, 93
 F. or T. 2-7, 8
 Asynchrony, metabolic. 16-80, 85, 92
 F. or T. 16-27
 Atelectasis 7-21, 29
 10-53, 55
 F. or T. 11-8, 16
 12-31
 Athlete. 10-7, 18, 19, 24
 F. or T. 10-15, 16
 Atmosphere. See also Gas
 2-8, 12, 13, 27, 28, 108 to
 110
 F. or T. 2-6, 27, 77
 3-44, 81
 F. or T. 3-16
 5-20
 6-6 to 10, 19 to 52, 81
 F. or T. 6-4, 6, 13
 7-29
 9-7 to 11, 31, 81, 82
 F. or T. 9-28, 32
 10-46 to 76
 F. or T. 10-34 to 49
 11-1 to 39
 F. or T. 11-1 to 16
 12-1 to 41
 F. or T. 12-1 to 23
 13-4 to 8
 14-3 to 8, 14
 F. or T. 14-2 to 6 (cont)

Atmosphere (cont). 15-4, 12, 16
 F. or T. 15-6
 16-43
 Atmospheric pressure See Barometric pressure
 Atmospheric temperature (ambient). 6-7, 10 to 12, 15, 16, 27 to
 71, 73, 81, 90, 98, 103,
 107, 112 to 116, 121
 F. or T. 6-3, 6, 7, 8, 10, 12,
 26 to 32, 34 to 41, 43, 49,
 58 to 69, 71 to 88, 91 to
 93, 95, 97 to 99, 101 to
 113
 F. or T. 10-4
 15-4, 12, 13
 F. or T. 15-4, 6, 10
 Atom 3-27
 F. or T. 3-6
 Atom bomb See Nuclear weapons
 Atom Bomb Casualty Commission. 3-73, 76
 Atomic number 3-2, 10, 42, 88
 F. or T. 3-6, 16, 18
 F. or T. 11-1
 Atomic weight See also Molecular weight
 F. or T. 3-6
 Atrophy 3-59, 71
 F. or T. 3-3
 Atropine F. or T. 6-66
 F. or T. 7-78
 Attack time 9-37, 38
 Attention. See also Vigilance
 8-85
 F. or T. 8-20, 39
 9-5, 31, 49 to 51, 81
 10-53, 70, 71, 75
 F. or T. 10-39
 16-87
 F. or T. 7-65
 Attention span F. or T. 7-65
 Attenuation, sound See also Damping
 8-34
 F. or T. 8-19
 9-5 to 10, 36 to 39, 58 to 82
 F. or T. 9-3, 30, 31, 38 to
 52
 Attitude 7-5, 90
 F. or T. 7-65
 Attitude control. 16-38
 F. or T. 16-13, 14
 Attitude vehicle. F. or T. 6-4
 Audiofrequency See also Acoustic effects
 (cont)

Audiofrequency (cont) 8-34
 F. or T. 8-19, 27
 9-1 to 82
 Audiogram 12-39
 F. or T. 12-23
 Audiogyral illusion 7-94
 Audiometry See Measurement and Audio-
 gram
 Auditory function See also Acoustic effects
 7-38, 46, 94
 F. or T. 7-36
 11-8
 Auditory nerve (pathway). 9-3, 5, 48
 F. or T. 9-2
 Auditory sensitivity 16-78
 Autokinetic illusion 2-95
 7-91
 F. or T. 7-65
 Automatic gain control (AGC). 9-36 to 39
 Automatic volume control (AVC) 9-37
 Automobile See also Land vehicles
 8-65, 91
 F. or T. 8-32
 F. or T. 9-3, 10
 Automobile accidents 7-197, 221
 F. or T. 7-77
 Autonomic nervous system See also Sympathetic and
 Parasympathetic systems
 7-46, 48, 62, 82, 83, 117,
 199
 F. or T. 7-63, 78
 8-48, 49
 F. or T. 13-18
 Average body dose (ABD) 3-29
 Awakening 16-87, 89 to 92
 Axes. See also Planes and Rotation
 16-36, 47, 55, 62, 65
 F. or T. 16-7, 12, 14, 18,
 23, 24
 Axilla 13-92
 F. or T. 13-12
 Axis of acceleration and rotation See also specific axes
 7-1, 4, 91, 93, 96 to 101,
 106, 197, 205 to 211
 F. or T. 7-1, 52 to 61, 85
 to 88
 Axis of vibration See also specific G axis
 8-36

B

- Back 6-73
 F. or T. 6-54, 57
 7-5, 6, 29, 35, 209
 F. or T. 7-2, 5, 7 to 11, 16,
 17, 85 to 88, 91
 8-14 to 17
 F. or T. 13-11
 F. or T. 16-4, 17, 18, 22
- Back angle 7-6, 8, 29, 35, 40, 179 to
 181
 F. or T. 7-2, 5, 7 to 12,
 16, 17, 70, 71
- Background luminance 2-8, 15, 20, 31, 32, 51,
 52, 53, 56, 57, 69 to
 74
 F. or T. 2-9, 13, 15, 16,
 17, 20, 21, 23, 24, 27,
 29, 30, 35, 59, 60, 66
 to 68
 7-41
 F. or T. 7-21
- Background radiation See Cosmic radiation
- Backpack. See also Load, carriage
 7-133 to 150, 181, 187
 F. or T. 7-71
 10-26 to 30, 38, 40, 42
 F. or T. 10-13
 11-20, 21
 12-27
 F. or T. 12-19
 16-26
 F. or T. 16-22, 23
- Bacteria F. or T. 11-8, 16
 13-91 to 93
 14-9
 F. or T. 14-7
 15-13, 16, 20 to 26
 F. or T. 15-14, 17
- Bacterial regenerative systems. 14-3
- Balance See also Posture and Vestib-
 ular organs
 9-50, 52, 57
- Balance test 7-106
- Balanced controller See also Controls
 7-48
 F. or T. 7-28
- Balke test F. or T. 11-8

Ballistocardiography . . . . .	.8-11
Bands . . . . .	.See also Octave bands 9-18, 21, 22, 41, 42, 48, 50, 53 to 55, 59 to 75 F. or T. 9-12 to 14, 36, 38 to 49
Bantu . . . . .	.F. or T. 6-60
Barometric pressure . . . . .	.See also Atmospheric pres- sure and Pressure, static 6-10, 36 to 52, 71, 73, 81 F. or T. 6-1, 4, 30 to 32, 34 to 41, 49, 61 to 63, 66, 71, 78 7-5 F. or T. 7-14, 15 10-1, 22 to 25, 46 to 76 F. or T. 10-7, 18, 34 to 49 11-3, 8 F. or T. 11-1, 6, 7 12-1 to 41 F. or T. 12-1 to 23 13-5, 6, 15 to 17, 86 F. or T. 13-23 15-4
Barracks . . . . .	.16-75 F. or T. 16-26
Barrier . . . . .	.14-32 F. or T. 14-15 to 17
Bars . . . . .	.2-18, 19, 70, 71, 104 F. or T. 2-20, 21, 58
Basal cell carcinoma . . . . .	.3-71
Basal metabolic rate . . . . .	.See also Metabolic rate 6-152 14-38 F. or T. 14-20
Base, military . . . . .	.15-13 F. or T. 15-11
Base, organic . . . . .	.13-11 F. or T. 13-3, 7, 8
Basilar membrane . . . . .	.9-3 F. or T. 9-2
Beans . . . . .	.F. or T. 13-6
Bears . . . . .	.7-190, 212 8-17
Bed . . . . .	.16-69, 81, 82 F. or T. 16-25, 26
Bed, prone . . . . .	.F. or T. 7-16

Bed rest 7-29, 112 to 176
 F. or T. 7-64
 10-25
 Behavior See also Performance
 3-46, 62, 82 to 84
 10-69 to 71, 75
 F. or T. 10-47, 49
 12-31
 16-69 to 96
 Belding-Hatch stress index 6-16, 90, 92
 F. or T. 6-74, 75
 Bellows, joint 12-27
 Belt, garment 16-84
 Belt, lap or seat See also Restraints and
 Protective devices
 7-199, 220
 F. or T. 7-7, 9, 11, 18
 8-5, 40 to 46, 91 to 94
 F. or T. 8-6, 22, 30
 Bends See also Flexion and Extension
 F. or T. 11-8, 16
 12-3 to 10
 16-48, 55, 62, 65
 F. or T. 16-22, 23
 Bernadini F. or T. 7-16
 Beryllium 13-81
 Beverage 14-15
 F. or T. 14-8, 9, 14
 Bias, linear G See Acceleration, linear
 Bicarbonate 10-43 to 45, 71 to 76
 F. or T. 10-33, 50
 Biceps F. or T. 16-11
 Bicycling 10-18
 F. or T. 10-1, 7
 Bile 15-1
 F. or T. 15-1
 Bilirubin F. or T. 10-41
 F. or T. 11-8
 14-36
 Binocular parallax See also Parallax
 F. or T. 2-15
 Binocular visual acuity 7-90, 91
 F. or T. 7-23, 24
 Biochemical responses (mechanisms) 7-85, 102
 F. or T. 10-47
 13-9 to 17
 Biological end point 3-4, 63
 Biomechanics 7-190 to 195
 8-6 to 34, 85 to 94
 F. or T. 8-4 to 19
 9-97
 F. or T. 9-2 (cont)

Biomechanics (cont). 16-2, 3, 16, 47
 Biorhythms 16-1, 79 to 96
 Biothermal equation. 6-5 to 8, 32, 33
 F. or T. 6-1
 Bits F. or T. 9-11
 Bivouac F. or T. 15-4
 Black body temperature 6-20
 F. or T. 6-15
 Blackout 7-5, 6, 12, 16, 21
 F. or T. 7-16, 19
 Bladder F. or T. 13-5
 Bladder, anti G. F. or T. 7-18
 Bladder, urinary 8-32
 Blast (overpressure) 7-212 to 221
 F. or T. 7-94
 F. or T. 8-3
 9-41, 42, 47, 55, 56, 61
 F. or T. 9-37
 F. or T. 11-16
 12-1, 34 to 41
 F. or T. 12-1, 20 to 23
 Bleaching 2-114
 Bleeding See also Hemorrhage
 F. or T. 11-8
 Blind spot See Optic disc
 Blindness See Flash blindness and
 Retinal burns
 12-4
 Blinking lights 7-91
 Blister 8-45
 Blister, skin 3-46, 57
 F. or T. 3-45
 Blood See also Hematopoietic and
 Hematological syndrome
 and Hemoglobin
 1-8, 9
 7-6, 16, 21, 57, 112 to 123
 F. or T. 7-2, 14, 15
 8-34 to 36, 48
 F. or T. 8-19
 9-49, 58
 10-55, 69, 71 to 76
 F. or T. 10-41
 F. or T. 11-3, 8, 16
 12-1, 31 to 34, 40
 13-11, 86
 F. or T. 13-18
 14-2, 36
 F. or T. 14-19 (cont)

Blood (cont)	15-1
	F. or T. 15-2, 9
	16-69, 87, 94
	F. or T. 16-27
Blood flow	See also Vasomotor control
	F. or T. 6-65, 89
	9-48
	F. or T. 9-35
	F. or T. 16-27
Blood lactate	14-35, 40
Blood pressure	1-11
	7-16, 17, 39, 57, 61, 62, 115,
	116 to 123, 197
	F. or T. 7-32, 63, 78, 87
	8-36, 48
	9-48
	10-71
	12-4, 32
	16-69, 94
Blood sugar	F. or T. 6-105
	14-35, 36
	16-94
Blood vessel (circulation)	See also specific type
	5-12, 13, 14
	7-39
	8-34 to 36, 48
	9-48
	F. or T. 9-35
	12-2, 4, 30 to 35
	15-1
Blood volume	F. or T. 6-89
	7-16, 115 to 123
	F. or T. 7-63
	F. or T. 11-8
	14-36
	F. or T. 14-19
	F. or T. 15-9
Blurring, visual	16-94
B. M. R.	See also Metabolic
	10-5, 6, 22
	F. or T. 10-1, 2, 17
Boats	8-35, 46, 56
Bode plots	See Phase angle
Body build	12-2
Body burden	3-89
Body dimensions	See Anthropometry
Body lean (angle)	7-181 to 183
	F. or T. 7-71, 73
Body position	See Posture
Body resistance	5-3 to 6
	F. or T. 5-2

Body size or weight See also Weight
 10-7
 F. or T. 10-4
 14-1, 29, 34 to 42
 F. or T. 14-6, 18
 Body storage index See Storage, heat
 Body temperature, mean 6-71, 73, 91, 98, 112, 113, 114,
 115, 116, 121
 F. or T. 6-90, 92, 93, 100,
 102, 103, 106
 Body water, total F. or T. 11-8
 15-1, 7, 9, 11,
 F. or T. 15-9
 Boil 5-8, 9
 Bone F. or T. 1-3
 3-10, 27, 38, 48, 77, 78
 F. or T. 3-6, 8, 9, 10, 12, 27,
 116
 5-7, 8, 14
 F. or T. 6-65
 7-126, 191, 216, 217
 F. or T. 7-63, 74
 8-32, 34
 F. or T. 8-19, 21
 9-18
 10-73, 74
 12-4, 40
 Bone marrow See Marrow and Hematopoietic
 system
 F. or T. 1-2
 Booster, spacecraft 8-1, 17, 89, 91
 9-1, 5 to 10, 75 to 82
 F. or T. 9-3
 Boots See also Shoes
 F. or T. 6-102
 Boranes 13-81
 F. or T. 13-20
 Border See Contour sharpness
 Border comfort-discomfort (BCD) 2-53, 56
 F. or T. 2-46
 Boredom 16-79, 91
 Boreman 7-131
 Bowel See Intestinal tract
 Bracing 10-28, 30
 F. or T. 10-20
 Bradycardia 7-117, 199
 F. or T. 7-78
 12-31, 40
 Bragg peak 3-88
 Brain See also Central nervous
 system and Cerebral
 function and Mental function

Brain (cont)	1-8
	F. or T. 1-2
	5-7, 8
	7-6, 49, 57, 64, 213, 215
	F. or T. 7-32, 90, 94
	8-34
	9-3, 48, 57
	F. or T. 9-2
	10-48, 69, 71, 75
	12-2, 30, 33, 34, 40, 41
	F. or T. 13-15
	16-94
Brain damage	6-50
Brain stem	7-64
Braking, space vehicle	2-101 to 105
Breadth	16-49
	F. or T. 16-2 to 10, 9 to 11
Break-out force	7-48
Break-through curves	13-8
Breast bone	12-4
Breathing	7-5, 12, 19
	F. or T. 7-13 to 15
Bremsstrahlung	3-18
	F. or T. 3-13
Brief acceleration	See also Impact
	7-4
Brightness	See Luminance and Illumination
Brightness contrast threshold	See Brightness discrimination
Brightness discrimination	2-20, 90
	F. or T. 2-13
	4-2
	7-39, 41, 132, 133
	F. or T. 7-21, 22
	8-70 to 76
	10-49
	F. or T. 10-38, 47
British	6-9, 90, 98
	F. or T. 6-92
British comfort index	6-9
Bromine	3-88
Bronchial spasm	13-55
	F. or T. 13-15
Bronchioles	10-53
	F. or T. 11-8
	12-29, 31
	13-55
	F. or T. 13-15
Bronchitis	F. or T. 11-8
Bruise	7-197, 199, 215
	F. or T. 7-91

Eubbles	12-2 to 13, 30 to 34, 40, 41
Buffeting	See also Random vibration 8-35, 40 to 46, 51, 56 to 58 77, 79, 83, 85, 92 to 94 F. or T. 8-25, 35, 50
Build, body	8-5
Buildup rate	13-5 to 9
Bulk	14-2, 8 F. or T. 14-6
B. U. N.	F. or T. 11-8
Bungee cord	7-118
Bunsen coefficient.	See Solubility
Burn, skin	See Skinburns
Burning rate	10-58 to 60 F. or T. 10-42 to 44
Buttocks (rump)	See also Gluteal F. or T. 6-29, 54, 94 7-12, 215 8-41 F. or T. 8-20 16-26 F. or T. 16-2 to 4, 9 to 11
Button	F. or T. 16-20
Bykovsky.	7-131 F. or T. 7-63

C

Cabbage	F. or T. 13-6
Cabin	See Space cabin and specific cabin function
Cabin atmosphere	See also Atmosphere and Atmospheric pressure 11-1 to 38 F. or T. 11-1 to 16 12-11, 13, 16 to 30 F. or T. 12-9, 10, 12 to 19 13-5, 6, 15 to 17, 86 F. or T. 13-23
Cabin pressurization	10-42
Cabin seal	See Sealing technology
Cadaver	7-213, 216, 217, 218 F. or T. 7-90
Cadence	F. or T. 10-12
Cage restraints	7-174 to 176
Calcium	3-30 F. or T. 3-6, 16, 17 7-126 F. or T. 7-63 10-71, 73 14-2 (cont)

Calcium (cont) F. or T. 14-1, 6, 11, 13, 19
 16-81
 Calculation (computation) 10-49
 F. or T. 10-39
 Calf F. or T. 6-26, 27, 28, 29,
 45, 54, 94
 7-21
 F. or T. 7-86
 F. or T. 16-4, 11, 23
 Caloric testing 7-62, 83, 106, 132
 Calories See also Metabolic rate and
 Metabolism
 14-1, 3 to 8, 17, 24, 29, 34
 to 42
 F. or T. 14-1, 2 to 8, 11, 13
 Calorimetry F. or T. 6-31
 10-1
 Cancer See Carcinogenesis and Neo-
 plastic disease
 Candlepower F. or T. 2-3, 4, 5
 Candlepower-seconds F. or T. 2-5
 Candles and candelas 2-1
 F. or T. 2-3, 4, 5
 Canister 10-42 to 46
 Canned food F. or T. 14-8
 Cap F. or T. 16-9
 Capacitance 5-1, 2, 3
 Capacitive probes 8-8
 Cape Kennedy 16-83 to 85
 Capillary 2-111
 3-59
 8-35
 10-24
 Capillary flow, gas 11-12, 20
 F. or T. 11-9
 Capsule, escape or emergency See also Cabin
 F. or T. 7-7, 15, 39, 40, 175
 8-56
 Captive firing, rockets 9-9
 Car sickness See also Motion sickness
 7-82
 Carbohydrate 10-1, 22
 F. or T. 10-1, 2, 4, 5
 14-2 to 8, 42
 F. or T. 14-1 to 6, 9, 11, 13
 15-8, 9, 12
 F. or T. 15-7
 Carbon 3-18, 30
 F. or T. 3-6, 7, 15 to 17, 21
 F. or T. 13-22

Carbon dioxide 6-25, 81
 F. or T. 6-4, 13
 10-1, 25, 42 to 45, 46 to 48,
 60 to 76
 F. or T. 10-1, 34, 46 to 50
 12-1, 32, 33
 13-3, 10, 16, 17
 F. or T. 13-5, 6, 15 to 19
 14-3 to 8
 F. or T. 14-2 to 6
 15-3, 4
 F. or T. 15-5, 7, 13
 16-43

Carbon monoxide 2-68
 F. or T. 2-57
 7-21
 13-10, 17, 79, 82, 84
 F. or T. 13-15 to 19, 21

Carbon tetrachloride 13-2, 16

Carbonates 10-44, 45

Carbonyl fluoride 13-80
 F. or T. 13-19

Carboxyhemoglobin F. or T. 13-15

Carcinogenesis See also Neoplasia and
 Neoplastic disease
 3-70, 71, 73, 76 to 78

Card sorting 10-69

Cardiac arrest 5-11, 12, 14
 F. or T. 5-5

Cardiac massage 5-20

Cardiac output 7-57, 62, 115, 117 to 123
 8-48
 F. or T. 8-28

Cardiovascular See also specific area
 7-12, 16, 17, 19, 21, 29, 35
 to 40, 56 to 62, 110 to 125,
 197 to 199, 213, 215
 F. or T. 7-63, 64, 78, 85 to
 88
 15-12

Cardiovascular collapse 12-4, 30 to 34

Cardiovascular control F. or T. 11-8

Cardiovascular deconditioning 7-29, 110 to 126
 10-66, 74

Cardiovascular system (function) See also Vasomotor control
 8-36, 48
 F. or T. 8-28, 31
 F. or T. 13-18
 9-48, 49
 F. or T. 9-35
 16-70
 F. or T. 16-27

Career	3-63 to 67, 80, 84, 85
Carotenoids	2-112
Carotid artery	7-17 12-33
Carotid bodies	10-24
Carotid sinus	7-17, 199 F. or T. 7-32
Cascade	3-32, 33, 44
Casualties	F. or T. 7-91
Cat	9-57
Cataract	1-7 to 10 2-117 3-28, 68 to 70 F. or T. 3-56 to 58 5-14
Catecholamines	F. or T. 11-8 16-70
Cathode ray tube displays (CRT)	2-50, 87 to 91 F. or T. 2-66 to 70
Caution system	9-77 to 82
Cavitation	9-57
Celestial navigation	2-57, 58, 97 to 101 F. or T. 2-73, 74
Cells and tissues	1-6, 7 3-59, 63, 88 F. or T. 3-16, 20 5-1, 2, 3, 12 8-7 F. or T. 8-19 13-11, 12
Cellulose acetate	F. or T. 10-44
Cement	13-26 to 71
Center of gravity	8-20 16-3, 16, 26, 49 F. or T. 16-5, 6, 11
Center of rotation	7-56 to 62, 96 to 110 F. or T. 7-32 to 34, 57 to 61
Central nervous system (CNS)	See specific part 3-47 to 49, 82, 83 F. or T. 3-37 7-213 13-11 F. or T. 13-15, 18 16-78
Central vision	See Retina, Visual fields and Fovea
Centrifugal force	7-56, 83, 105
Centrifugation, prophylactic	7-119, 123 F. or T. 7-64
Centripetal acceleration	7-62
Cerebral arteries	12-32 to 34

Cerebral edema 5-20
 Cerebral function 7-49 to 56, 57, 127, 132
 F. or T. 7-32
 Cerebrospinal fluid (CSF) 8-17, 34
 Cervical See Neck
 Cesium-137 3-52
 F. or T. 3-40
 CHABA 9-61 to 76
 F. or T. 9-39 to 49
 Chambers (vacuum) See also Simulator and Vacuum
 12-26 to 30, 33
 F. or T. 16-25, 26
 Charge (electric) 3-26, 28, 38
 F. or T. 3-19
 4-3
 5-1, 2, 3
 Chart F. or T. 2-60
 Check list 7-153 to 158
 Cheek F. or T. 6-95
 F. or T. 16-4
 Chemical methods. See Drugs
 Chemical oxygen demand test 15-19, 20
 F. or T. 15-16
 Chemical (reaction rate). 4-1 to 3
 Chemicals See specific contaminant agents
 in Tables 13-3 to 18, 24
 Chemicals, water. 15-16 to 26
 F. or T. 15-14 to 17
 Chemisorbtion See Absorption
 Chest See also Thorax
 3-87
 7-17, 19, 35, 209, 211, 215,
 220
 F. or T. 7-86, 87
 9-47, 53 to 55
 F. or T. 9-36
 F. or T. 11-8
 F. or T. 13-11
 F. or T. 16-4, 9, 11
 Chest pack, EVA See also Back pack
 7-133 to 168
 F. or T. 7-66
 10-26
 Chest to back. See also G
 F. or T. 7^x-1
 Chewing 13-26
 Chickens 9-51
 Chills F. or T. 6-107
 10-69
 Chimpanzee F. or T. 7-79, 80
 12-31

Chlorate candles	10-43, 46 F. or T. 10-33
Chloride	7-126 14-2, 29 F. or T. 14-11, 13, 19
Chlorine	F. or T. 13-15 to 18
Chlorine trifluoride (ClF_3)	F. or T. 13-20
Choice reaction tasks	9-49
Chokes.	12-3, 4
Choking	F. or T. 8-20
Cholesterol	F. or T. 7-63
Chromatic aberrations.	2-25
Chromaticity values.	2-33, 114
Chromatograph	11-39 13-85
Chromophore (color pigment)	2-114, 120
Chromosome	3-53, 77 7-16 8-35
Chronic radiodermatitis	See Necrosis (late) of skin
Cigarette smoke	F. or T. 13-17
Cilia.	13-86 to 91
Cineroentgenography	8-8
Circadian rhythm	16-80 to 96 F. or T. 16-27 to 30
Circuit	F. or T. 5-2
Circulation, blood.	12-4, 30 to 35, 40, 41
Circumference	F. or T. 16-2, 11
Clamminess	F. or T. 6-90
Clamps	7-168 to 176
Clathrate.	11-19
Clausius-Clapeyron factors	12-30
Clavicle	7-35
Cleaning	F. or T. 15-12
Cleaning, baths.	9-57
Clearance	F. or T. 16-8
Climate	F. or T. 6-10, 60
Climbing.	See also Uphill walking 7-94, 183 F. or T. 7-73 10-15, 17 F. or T. 10-7, 8, 11, 13 16-48, 49 F. or T. 16-22
Clinical problems.	9-57
Clipping, speech	9-26 to 29, 36 to 39 F. or T. 9-18, 21, 30
Clo	See Clothing conductance and insulation
Clock systems	16-80 F. or T. 16-27

Closing 16-54
 Closure rate 2-101 to 105
 F. or T. 2-72, 76
 Clothing See also Space suit
 3-62
 6-7, 9, 25, 27 to 32, 41 to 70,
 90, 107, 115, 116, 121
 F. or T. 6-4, 7, 8, 9, 17, 18,
 19, 20, 61 to 63, 64, 67,
 69, 78, 80, 81, 94, 97,
 101 to 105, 109, 112
 7-16
 F. or T. 7-65, 73, 192
 8-11
 F. or T. 8-5
 9-52, 57
 10-30 to 46, 60
 F. or T. 10-8, 20 to 30
 F. or T. 13-11, 15
 F. or T. 15-6, 12, 18
 16-1, 2, 21, 36, 48 to 65
 F. or T. 16-9, 18 to 23
 Clothing absorbance F. or T. 6-4
 Clothing conductance and insulation 6-27, 36, 44 to 56, 64, 73,
 113 to 116
 F. or T. 6-1, 35 to 41, 44,
 45, 51, 64, 78, 91, 93,
 94, 98, 101
 Clothing emissivity 6-20, 22, 52, 91
 F. or T. 6-1, 20
 Clothing thermal resistance See Clothing conductance and
 insulation
 Clothing vapor resistance 6-36, 40, 52 to 60
 F. or T. 6-1, 30, 31, 45
 Cloud 2-8, 11, 12, 96
 F. or T. 2-6, 7
 CNS See Brain and Spinal cord
 and Central nervous system
 Cobalt⁶⁰ 3-26, 28, 81
 Cochlea 9-1, 3, 40, 48
 F. or T. 9-2
 Cockpit See also Space cabin
 2-28, 75
 F. or T. 2-60
 F. or T. 16-17, 25
 Coding 16-86, 87
 Cold See also Stress, cold
 6-69, 72, 107 to 127
 F. or T. 6-72, 75, 80 to 113
 7-16
 8-35
 10-66, 67 (cont)

Cold (cont) F. or T. 10-47
 14-38
 Cold injury 6-107, 121
 F. or T. 6-72, 75
 Cold water 6-116, 121
 Coliforms See also Bacteria
 15-20, 21
 Collagen 7-126
 F. or T. 8-19, 21
 Collapse 6-81
 F. or T. 6-60, 77, 92, 93
 F. or T. 10-38, 39, 47
 12-4, 28 to 34
 F. or T. 13-15, 21
 F. or T. 15-9
 Collar 7-105
 Collision F. or T. 3-11, 12
 Colon 8-17, 34
 F. or T. 8-13
 Color See also Color vision
 F. or T. 6-4
 F. or T. 15-14, 15, 17
 Color blindness 2-33
 Color coding 2-33, 35, 73, 90
 F. or T. 2-32
 Color discrimination See also Redout
 2-31, 32, 33, 37, 38, 73, 74
 F. or T. 2-13, 30, 31
 7-46
 Color distortion F. or T. 10-47
 Color naming 7-49
 16-94
 Color preference 2-74, 75, 76
 Color, skin 2-111 to 114
 Color vision 2-20, 28 to 33, 37, 38, 73 to
 78, 86, 90
 F. or T. 2-6, 13, 28, 29, 30,
 34, 36, 38, 42, 43, 72
 Coma 5-9
 12-4, 28 to 34
 F. or T. 13-15
 Combined stress 3-80
 F. or T. 3-65
 7-48, 90
 8-13 to 16, 51, 89 to 91
 F. or T. 8-11
 9-51
 10-15, 22 to 25, 38, 40, 63,
 65, 66, 67
 F. or T. 10-48, 49
 14-38
 15-6, 11, 12
 F. or T. 16-49 to 63

Computer (programs) (cont)	F. or T. 7-81 10-30 12-9 16-16, 78
Concentration	See Dose
Concentration, mental	See also Mental function and Vigilance and Attention (span) 7-49 8-74, 77, 78 F. or T. 8-20, 25, 36, 39
Concrete	F. or T. 5-2
Concurrent illness	3-52, 53
Concussion	7-213 F. or T. 7-83, 87, 88, 90
Condensation	See also Cryogenic trapping F. or T. 15-2
Conditioning, physical	See also Training 10-18
Conductance, airway	10-53
Conduction, thermal	6-1, 7, 8, 10, 25, 27 to 32, 58 to 71, 107 F. or T. 6-1, 2, 7, 13, 15, 20, 21, 23, 24, 25, 29, 56, 57, 58, 64, 65, 78, 89, 90 15-5
Conductivity	5-1, 2, 3
Conductivity (tissue)	1-10
Cones	2-1, 15, 23, 42 F. or T. 2-35, 43
Confinement	7-115 16-69 to 78, 94 F. or T. 16-25, 26
Conflict, mental	16-77 to 79
Conflict, stimuli	7-85 to 110 F. or T. 7-55 to 57
Confusional state	5-9 7-12, 17, 57 F. or T. 7-6, 83, 87 8-44 to 46
Congestion, vascular	7-17, 59, 61
Conjugation	13-12
Conjunctiva	2-115 7-17, 57 F. or T. 7-19, 32 F. or T. 13-15
Conjunctivitis	F. or T. 11-8
Connector mating (connecting)	7-188, 189 F. or T. 7-70 16-54 to 65 F. or T. 16-21, 22

Control device or procedure See also specific device
7-19, 38, 48 to 56, 64, 67, 95
F. or T. 7-3, 28 to 31, 52

Control dynamics See also Man-machine systems
7-48, 64, 67, 76 to 82, 110,
132
F. or T. 7-28, 36, 43 to 51
16-16, 36 to 43
F. or T. 16-12 to 25

Control friction 7-48

Control, hand See also Side-arm control
7-38
F. or T. 7-28 to 31, 65
8-5, 78 to 94

Control mode. 2-104

Control of atmosphere. 11-34, 39

Control room. 9-28
F. or T. 9-26

Control surface. 8-90
F. or T. 8-32

Control (system and task) 8-78 to 94
F. or T. 8-48 to 51
9-80 to 82
16-1, 3, 43, 49, 54 to 65, 95,
96
F. or T. 16-7, 8, 18 to 22

Contusion See Bruise

Contusion, lung 12-27 to 30

Convection. 6-1, 6, 8, 10, 11, 19, 25 to
32, 42 to 62, 69, 70, 107,
112 to 116
F. or T. 6-1, 2, 7, 21, 23,
24, 25, 35 to 43, 78, 95
7-83
F. or T. 15-5

Convection, free 6-28, 32
F. or T. 6-37

Convective conductance See also Conductance, thermal
6-10, 25, 27 to 32, 52 to 62
F. or T. 6-1, 5, 21, 23 to 25,
77

Convergence, visual 2-110
F. or T. 10-36

Conversation. See Communication and Speech
and Voice

Convulsion. 3-49
5-9
7-12
10-70
F. or T. 10-40
12-4, 28 to 34

Cooking 13-26
 Coolanols 13-26
 Coolers F. or T. 14-7, 8
 Cooling 11-8
 Cooling, evaporative See Evaporation
 Cooling power See Windchill index
 Cooling rate See Heat transfer, overall
 Cooper F. or T. 7-63
 Coordinates F. or T. 16-7
 Coordination 6-125
 7-85, 105, 106
 F. or T. 7-61, 63, 78
 8-78
 F. or T. 8-39
 9-53 to 55
 F. or T. 9-36
 10-49, 69, 70, 71, 75
 F. or T. 10-47
 14-36
 16-49, 95
 Core, body. 6-73, 81, 107, 112
 F. or T. 6-60, 64
 Core, ionization 3-26
 Core temperature. See Rectal temperature, Body
 temperature
 Coriolis phenomena 7-66, 83, 95, 96 to 110, 132
 F. or T. 7-52, 53, 55, 58 to
 62, 65
 Cornea 2-1, 115 to 120
 F. or T. 2-1, 54
 F. or T. 7-41
 13-10, 49
 F. or T. 13-15
 Corneal burns 3-69, 89
 Corneum. 2-111 to 115
 F. or T. 2-79
 Corona, spacecraft 2-13
 Coronal plane F. or T. 7-87
 Coronary occlusion 12-4, 30 to 35, 40
 Correlation process. 7-38
 Cortisone See also Adrenal (hormone)
 3-82
 F. or T. 16-27
 Cosmic radiation 3-1, 18, 26, 29, 30, 33, 44,
 45, 66, 74, 76, 83, 84,
 87, 88
 F. or T. 3-16, 23, 28, 63
 Cosmonaut 3-45
 16-84, 85
 Cotton F. or T. 6-45
 10-60
 F. or T. 10-42, 44, 45

Couch See also Adjustable Couch and
Contour couch
8-36 to 45, 75, 92 to 94
F. or T. 8-24, 25
16-26, 49, 65, 84, 85
F. or T. 16-21, 22

Couch (contour). See also Adjustable Couch
7-5, 8, 17, 35, 205 to 211,
220, 221
F. or T. 7-5, 10 to 12, 16,
85 to 88
8-44, 45, 75, 92 to 94
F. or T. 8-24, 25

Cough 9-53 to 55
F. or T. 9-36
F. or T. 10-40
F. or T. 11-8
12-4
F. or T. 13-15

Counter 2-87

Counter roll, eyes 7-73, 74, 132
F. or T. 7-48

Counter rotation (room or vehicle) F. or T. 7-55, 63

Countermeasures See Protective device

Counterpressure suit See also Spacesuit and Pres-
sure suit
12-10

Coupling 8-41, 91 to 94
F. or T. 8-25

Coupling, mechanical 7-191 to 195, 220, 221

Coverall garment 12-11, 12

Cows 9-51

Craig index 6-95

Cramp, muscle 7-12
14-38

Cranial temperature F. or T. 6-70

Cranium See Skull

Cranking (speed) 10-18
16-43

Crankshaft F. or T. 8-32

Crash, vehicular 8-21

Crater F. or T. 2-10

Crawling 7-48
16-48
F. or T. 16-22

Creatine 16-94

Crevice F. or T. 16-22

Crew See Astronaut and Pilot

Crew compartment See Space cabin

Crista F. or T. 7-35

Critical flicker fusion See Fusion frequency

Critical fusion frequency (CFF)	See Fusion frequency
Critical heat capacity	10-58
Critical properties	F. or T. 11-1
Critical time of exposure	12-15, 16 to 30
	F. or T. 12-12 to 23
Cross coupling	See also Coriolis phenomena
	7-48, 66, 77, 83, 97 to 110,
	127
	F. or T. 7-28, 52, 58 to 62,
	65
	16-38
Cross modality interactions	7-90 to 96, 102 to 110, 126
	to 132
Cross section, radiation.	1-15
	F. or T. 1-10 to 14
	3-18
Crotch	F. or T. 16-3, 4, 11
Crouched position.	8-5
Crumbling	14-14
	F. or T. 14-10
Crushable shock absorbers	7-221
Cryogenic storage	3-82
	11-25, 26
Cryogenic trapping	13-5
Cuff, inflatable.	7-119
	F. or T. 7-18
Cultural factor	16-74, 77 to 79
Culture techniques	15-20, 21
Cupula.	7-67, 104, 107
	F. or T. 7-35, 38, 39, 41,
	42, 47
Current path	5-7, 8
Current-to-dose conversion	See also Flux-to-dose con-
	version
	3-1, 31 to 33
	F. or T. 3-23 to 26
Cyanide	13-10
Cyanosis.	12-4
Cyclizine	7-90
Cyclogram.	10-36

D

Damage, ear.	9-40 to 47, 53 to 56
	F. or T. 9-36
Damage risk criteria or contours	9-58 to 76
	F. or T. 9-33, 38 to 49
Damage, threshold	9-3, 58 to 76
	F. or T. 9-3, 32, 33, 38 to 49
	F. or T. 12-12 to 20

Damping	7-48, 53, 67, 132, 191, 192, 203 F. or T. 7-28, 38, 42, 81 8-2, 6 to 34, 75, 77, 89, 91 to 94 F. or T. 8-3 to 8
Danger signals	9-77 to 82 F. or T. 9-26
Dark	7-91 F. or T. 7-57 16-49
Dark adaptation	2-42, 45, 46, 60, 77, 78, 86, 88, 89, 92, 93, 95, 98, 101 to 103, 108 to 110 F. or T. 2-41 to 44, 60, 67, 68 8-74 F. or T. 10-36, 38 F. or T. 11-8
Day-night cycle	See Circadian rhythm
Daylight vision	See Photopic vision
Daytime	F. or T. 13-6
Dazzle	2-58, 60
Dead band	7-48
Dead space, respiratory	10-72, 73 F. or T. 10-50
Deafness	See also Noise induced tem- porary threshold shift and Noise induced permanent threshold shift 9-40 to 48, 58 to 75 F. or T. 9-33, 34, 38 to 49 12-39 F. or T. 12-20, 22, 23 F. or T. 15-9
Death	See also Lethality and Sur- vival 5-11 F. or T. 6-77, 91, 104, 105 F. or T. 7-77, 83, 94 8-34, 35 12-4, 16 to 36, 40 F. or T. 12-20, 21 13-9, 15 F. or T. 13-15, 21 14-42 15-4, 9, 13 F. or T. 15-3, 9
Death rate	See also Life-shortening and Lethality F. or T. 16-27

Debris See Missile
 Decalcification 7-126
 Decay scheme 3-18
 Deceleration See also Impact
 7-59, 61, 82 to 96, 190 to 221
 F. or T. 7-34, 41, 52 to 57
 Decibel 9-2, 3 to 82
 F. or T. 9-1 to 52
 Decision making 10-69, 75
 F. or T. 10-39
 Decision time F. or T. 7-39
 Deck See Floor
 Decompression F. or T. 8-3
 F. or T. 10-32
 15-5
 F. or T. 15-5
 16-48, 55
 Decompression, explosive See Explosive decompression
 Decompression sickness 11-1
 F. or T. 11-8, 16
 12-1 to 11
 F. or T. 12-2 to 8
 Deconditioning See also Cardiovascular de-
 conditioning
 6-98
 7-29, 110 to 176
 8-1
 16-69, 70, 74
 Decrement See Performance
 Defecation F. or T. 8-20, 21
 Defection, visual 16-94
 Defibrillation, heart 5-15, 16, 20
 Deflection, sound 9-9 to 11
 Degaussing coils 4-2
 Degree of freedom 7-194, 195
 F. or T. 7-76, 81
 10-25, 28
 F. or T. 10-20
 Dehumidification See also Humidity
 11-32
 F. or T. 11-15, 16
 Dehydration, food 14-9, 16, 18, 29
 F. or T. 14-8
 Dehydration, human 6-71, 95
 7-16, 115, 118
 F. or T. 7-63
 14-38
 15-1, 4, 9 to 13
 F. or T. 15-9
 Dehydrocholesterol See Vitamin D
 Delayed effect See Late effects

Delirium.	F. or T. 6-90 12-4, 27 to 34 F. or T. 13-15 F. or T. 15-9
Denitrogenation	12-7 F. or T. 12-5 to 7
Densitometry, body.	16-21
Density	F. or T. 3-6 6-40 F. or T. 6-1, 13, 24, 41, 65, 78, 95 7-168, 212 F. or T. 7-35, 69, 74 8-5 10-22, 58 F. or T. 10-33 11-3, 31 to 33 F. or T. 11-1, 8 13-89, 91 14-8, 16, 17 F. or T. 14-6, 8 16-21 7-131
Depersonalization reaction	13-85 to 91
Deposition	F. or T. 13-23
Depressant, nervous	F. or T. 13-15, 18
Deprivation, sleep	16-81 to 96 F. or T. 16-30
Depth	3-7, 9, 30 to 33, 38, 42, 56, 60, 63, 87 F. or T. 3-22, 24, 25, 30 to 34, 39, 45 to 47, 61
Depth perception	2-42 F. or T. 2-13, 15, 39 7-133 F. or T. 8-39
Dermal	See Skin
Dermatitis.	See also Skin F. or T. 6-75 F. or T. 11-8 F. or T. 13-15 15-13
Dermatophytosis	2-111
Dermis	F. or T. 2-78
Desaturation	12-9 F. or T. 12-8
Descent	12-8
Desert	F. or T. 6-66
Desquamation, skin (dry or wet)	3-57, 59, 70 to 73 F. or T. 3-5, 31, 45 to 51, 59

Detectability	2-14 to 18, 20, 37, 38, 50, 70, 71, 85, 88, 89, 93, 97 to 101, 103 F. or T. 2-14, 16, 17, 35, 67, 72, 74
Detection time	See Detectability and Response time
Deterioration, food	14-2, 9
Development time	11-34 F. or T. 11-16
Dexterity, manual	9-51, 53 to 55 F. or T. 9-36 16-63, 64 F. or T. 16-23
Dew point	See Humidity
Dial.	2-82, 84, 85, 86 F. or T. 2-62
Dial reading	7-46 F. or T. 7-26 8-71 to 78, 90, 92, 93 F. or T. 8-45, 46 10-53
Diamagnetic effect	4-3
Diameter	13-85 to 91 F. or T. 13-22, 23
Diaphragm.	7-57 8-17 F. or T. 8-3 10-71
Diarrhea	3-46, 51 F. or T. 3-36, 42 F. or T. 13-15 15-1
Diathermy	1-6, 11
Dichloroacetylene	13-81
Dielectric constant	1-2, 4 F. or T. 1-2 5-2, 3
Diet.	See also Food and Nutrition F. or T. 6-90 13-17 F. or T. 13-3, 4 16-74, 76
Difference threshold (limen)	8-46 F. or T. 8-27 9-12 to 17 F. or T. 9-7
Differential equation of motion	7-67 F. or T. 7-35, 38, 39, 42
Differential pressure	12-16 to 30
Differential or pressure gradient. microphone	See Noise cancelling system

Diffraction errors	2-25
Diffusers	9-9
Diffusion (coefficient)	See also specific type
	4-3
	7-21
	10-58
	F. or T. 10-43
	12-32
	13-16
Diffusion (capacity), lung	7-21, 23
	F. or T. 11-8
Diffusion, light	2-74, 75, 77, 108
Diffusivity, vapor	6-33, 36 to 39, 41 to 43, 56,
	57
	F. or T. 6-1, 4, 30 to 32, 57,
	64, 66
Digit	F. or T. 9-27
Dilator	2-114
Diluent gas	See also Inert gas
	11-1 to 38
	F. or T. 11-1 to 9, 11, 13 to
	16
Dimension	See Anthropometry
Dimming, vision	See Gray out
Diplopia	7-39, 90, 91
	16-94
Direction	See also Motion and Force
	F. or T. 16-7, 12, 18
Directivity, noise	9-9
Disaccharide	F. or T. 15-7
Discharge current	5-15
	F. or T. 5-7, 8
Discipline	16-71
Discomfort	7-5, 12, 82, 83, 127, 131,
	190
	F. or T. 7-55
	8-5, 36 to 46, 48 to 51, 58,
	74, 91 to 94
	F. or T. 8-20 to 25, 30, 31
	F. or T. 10-47
	16-63, 70
Discomfort (threshold)	See also Comfort threshold
	9-3, 41, 58 to 76, 81
Disconnect	16-54 to 65
	F. or T. 16-21, 22
Disorientation	7-19, 82 to 110, 127 to 133,
	209
	F. or T. 7-52 to 63, 65, 87
	8-44 to 46
	F. or T. 8-25
	9-47, 48, 50, 51, 76
	F. or T. 10-47

Dispensing, food 14-14 to 18
 F. or T. 14-8
 Displacement 8-2
 F. or T. 8-1, 3, 4, 5
 Displacement, current 5-3
 Displacement, organ 7-194
 F. or T. 7-76, 89
 Displacement ratio F. or T. 14-21
 Displacement, target 7-90 to 94
 F. or T. 7-58, 63, 65
 Display See also CRT display and
 Instrument and Instrument
 display
 2-35, 50, 79 to 91
 F. or T. 2-32
 9-81, 82
 16-38, 47, 54 to 65, 84
 F. or T. 16-8, 22
 Dissociation, ionic 5-1
 Distance See also Visual range
 F. or T. 7-77
 9-22 to 24, 31, 61
 F. or T. 9-26
 F. or T. 10-36
 Distance judgement 15-16
 Distillation 15-16
 Distortion, frequency and amplitude 9-26 to 28, 39
 F. or T. 9-21
 Distortion, sensory 16-69, 77 to 79
 Distraction 10-70
 F. or T. 10-47
 13-10
 Diuresis 6-95
 7-115 to 125
 F. or T. 7-63
 14-38
 Diurnal rhythm (cycle) 6-7
 16-80 to 96
 F. or T. 16-27 to 30
 Dive 7-95
 Diver 16-21
 Dizziness 3-83
 7-19, 82 to 110, 131
 F. or T. 7-55 to 63, 87
 10-69 to 71
 F. or T. 10-40, 47
 F. or T. 13-15, 21
 F. or T. 15-9
 DMSO 3-82
 Docking 2-42, 92, 96, 97, 98, 101 to
 105
 F. or T. 2-72 to 75 (cont)

Docking (cont)	7-110, 190 16-43
Dog	7-57, 61, 213, 215 8-48 F. or T. 8-13 12-22, 23, 31 F. or T. 12-21 F. or T. 13-20
Dominant wavelength	F. or T. 2-2
Donning and doffing (suits).	7-168 16-48, 54 F. or T. 16-22, 23
Dosage	See also specific dose type and Exposure limit 2-114 3-31, 32, 33, 42, 44 to 89 F. or T. 3-16, 33 to 66
Dose, depth	3-7, 30 to 33, 42, 56, 70, 87, 88 F. or T. 3-22, 24, 25, 32, 33, 34, 45 to 47, 55, 58
Dose distribution	3-5 to 7, 18, 44, 48 to 51, 56, 58, 60, 61, 70, 72
Dose equivalent	See Roentgen equivalent man
Dose factor	See also Threshold limit value and Maximum allowable con- centration 13-9, 12 to 17
Dose fractionation	3-6, 42, 46, 56, 58 to 60, 62 to 80 F. or T. 3-48, 53 to 58
Dose limit	3-48, 63 to 67, 83 to 89
Dose maximum	3-83 to 89 F. or T. 3-24
Dose protraction	3-6, 8, 30, 42, 48, 53, 55 to 56, 58, 62 to 80, 83 F. or T. 3-22, 53 to 58
Dose rate	3-5 to 9, 18, 26, 45 to 81, 86 F. or T. 3-4, 5, 16, 45, 53 to 55, 56
Dose (rate) effectiveness factor	3-8, 10, 62 to 68 F. or T. 3-5
Dose, surface	3-42 F. or T. 3-24, 32, 33
Dosimetry	3-86 to 89
Drafty sensation	6-47, 49 F. or T. 6-39
Drag, aerodynamic (coefficient)	7-167 to 176 F. or T. 7-68, 69 10-17

Drag, underwater (coefficient) 7-167 to 176
 F. or T. 7-68, 69
 Dream (state) 7-12
 16-92
 Dress See Clothing
 Drilling 8-35
 9-57
 Drink See Water intake
 Drinking water See also Water
 13-92
 Driver 7-83
 Driving task F. or T. 10-7, 31, 32, 37
 Drizzle 9-10
 Drop hammer or forge 8-57
 Drop tower testing 7-205
 F. or T. 7-63, 84, 86
 Drowning F. or T. 6-104
 Drowsiness 7-82, 90
 8-46
 F. or T. 8-20
 10-24, 70
 F. or T. 10-47
 Drugs 2-68, 69
 7-90, 125
 12-34
 13-93
 Dry bulb temperature See also Atmospheric temper-
 ature
 F. or T. 11-6, 7
 Dummy 8-21
 Dura 5-13
 Duration of exposure See Exposure duration and
 Tolerance time
 3-6, 63 to 80, 83 to 89
 F. or T. 3-5, 26, 53 to 58
 5-14, 15, 16
 7-1, 4, 5, 17, 19, 21, 29, 35,
 39, 46, 48, 49, 53, 63, 64,
 91, 94, 102 to 110, 132,
 190, 194, 195, 197, 201,
 203, 215, 218, 220
 F. or T. 7-3, 5, 7 to 11, 14,
 16, 17, 19, 32 to 34, 38 to
 41, 46, 53, 56, 57, 73, 76,
 77, 79 to 86, 90 to 92
 8-2, 34, 36, 40 to 46, 56, 57,
 65, 72 to 78, 83, 85 to 91
 F. or T. 8-20, 28 to 31, 34
 to 37, 41, 43, 47, 50, 51
 9-1 to 3, 11, 12, 35 to 39,
 42, 49 to 55, 57 to 76
 (cont)

E

Ear	1-10 3-83 7-63 to 110, 213 F. or T. 7-35 to 63, 86 8-32 10-55 F. or T. 10-47, 11-8 12-30, 34, 35, 39 F. or T. 12-20, 22, 23 13-26 F. or T. 13-13 F. or T. 16-4, 19
Ear oximeter	F. or T. 7-14
Ear protectors (muffs)	See also Earplugs 9-50, 52 to 55, 58 to 82 F. or T. 9-36, 38, 51, 52
Eardrum.	7-213 8-33 9-3, 5, 31, 40, 41, 42, 53 to 55 F. or T. 9-36, 37 12-35, 39 F. or T. 12-20, 22, 23
Early response (effect)	3-4 to 10, 46 to 63 F. or T. 3-3, 5, 36 to 51
Earphone	9-12, 31, 39, 53 to 55 F. or T. 9-3, 36
Earplug	9-31, 52 to 55, 76 to 82 F. or T. 9-29, 36
Earth	See also Geomagnetic field 2-8, 11 to 13, 56, 69, 91, 92, 94 to 97, 108, 109 F. or T. 2-6, 10, 11, 58 3-1 6-8, 32, 52 F. or T. 6-4 7-75, 81, 83, 96, 99, 100, 179 to 190 F. or T. 7-47, 51, 57, 70, 73 10-6 F. or T. 10-23, 25, 28 to 30 13-85 to 91, 93 F. or T. 13-23 15-4, 5, 12 F. or T. 15-10, 11
Eating (habits and patterns)	F. or T. 10-31 14-8
Ebullism	12-13, 29 to 34

Economic factors.	8-58
	F. or T. 8-39
Edema, pulmonary	10-53
	F. or T. 13-15
Edema (swelling).	2-113
	3-57
	7-17, 59
	F. or T. 7-33
	12-29 to 34
	F. or T. 13-15
	15-1
	F. or T. 15-1
EEG	5-11
	F. or T. 7-78
	8-46, 48
	9-48, 49
	10-69
	F. or T. 11-8
	14-38
	16-78, 80, 93, 94
Effective physiological angle.	7-40
	F. or T. 7-2
Effective pressure	12-34
Effective radiant field.	6-10, 12
Effective temperature.	6-9, 98
	F. or T. 6-1, 6 to 9, 59, 60,
	84, 87, 88, 92
Effervescence	12-2, 32, 33
Efficiency (work or aerobic).	10-7, 22, 27, 28
	F. or T. 10-12, 13
Egress testing	7-166
Ejection seat.	7-56, 59, 62, 201, 218
	F. or T. 7-77, 80, 92
	F. or T. 16-7
EKG	1-11
	4-3
	7-115
	F. or T. 7-10, 78, 86
	8-34, 36
	9-49
	F. or T. 11-8
	12-34
	14-38
Elastic garments (suits).	12-10
	16-54
Elasticity	7-192, 197, 201
	F. or T. 7-74
	8-2, 6, 9, 13, 21 to 33
	F. or T. 8-3, 15, 16
Elastomers	8-32
Elbow	F. or T. 6-94
	7-35, 183 (cont)

Elbow (cont) F. or T. 7-86
8-21, 22
F. or T. 8-15
16-49, 55
F. or T. 16-2 to 7, 9, 11, 12,
14, 15, 23

Electric current 5-1 to 20
F. or T. 5-1 to 10

Electric heating See Heating methods

Electric power See Power, electric

Electric propulsion 4-1

Electric wire, insulation 10-57, 60
F. or T. 10-44, 45

Electrical equipment 13-79, 91

Electro-oculograph See Oculographic tracing

Electrocardiogram See EKG

Electrochemical effects 5-1, 2, 3

Electrode 5-3 to 8
F. or T. 5-1
16-93

Electroencephalography See EEG

Electroluminescent displays 2-91

Electrolysis, water 10-46

Electrolyte See also specific type and Salt
and Osmotic pressure
5-1 to 3
10-67, 72 to 74
F. or T. 10-50
F. or T. 11-8
13-11
F. or T. 13-3, 7 to 10, 13
15-6 to 8, 16 to 26
F. or T. 15-6, 14 to 17

Electrolytes, blood 7-126
F. or T. 7-126
14-36
F. or T. 14-19

Electrolytes, plasma 7-126
F. or T. 7-63

Electrolytic oxygen sensors 11-39

Electromyograph 7-48

Electron See also Artificial electron
belts
3-18, 26, 30, 33, 45, 48, 61,
71, 87
F. or T. 3-2, 11, 12, 63

Electron density F. or T. 3-6

Electronarcosis and anesthesia 16-95, 96

Electronic devices 4-2

Electroshock therapy 5-9

Elevator illusion 7-94

Elimination rates. 12-8, 9
 F. or T. 12-8, 19
 Elongation. F. or T. 14-15
 ELSS See Life support systems and Backpack
 Emboli 12-28 to 35, 40
 Emergency See also Contingency
 6-103
 7-38, 63, 201
 F. or T. 7-66
 10-23, 48 to 54, 57 to 76
 12-28, 30, 34
 14-3, 24, 29, 34 to 42
 F. or T. 14-11
 15-5, 6, 20
 F. or T. 15-5
 16-48, 54 to 64, 91, 92, 94 to 96
 F. or T. 16-20 to 22
 Emergency constraints F. or T. 14-7
 Emergency practices 5-20
 Emissivity. 6-9, 20, 22
 F. or T. 6-1, 4, 20, 35 to 37, 58, 64, 112, 145
 Emotion. See also specific type
 3-51, 82, 83
 F. or T. 3-65
 7-5, 48, 126
 16-77, 78, 94 to 96
 Emphysema 10-73 to 76
 12-31
 Empty field myopia 2-92, 93, 94
 End-spurt effects. 16-45
 Endocrine (hormones). 8-36, 51
 F. or T. 8-31
 9-48, 49, 51, 57
 16-80, 94
 F. or T. 16-27
 Endolymph. 7-83
 F. or T. 7-35, 38, 52
 Endothelium 2-116
 5-14
 Endpoint. 7-12
 F. or T. 7-5, 7, 9, 10, 11, 16, 17
 Endurance See also Maximum aerobic capacity
 10-18 to 25
 F. or T. 10-2, 11, 15
 Endurance time See Duration
 Energetics. 7-127, 177 to 190, 201, 220
 221
 F. or T. 7-89

Energy See also Calories and Meta-
bolic rate
2-60 to 67, 108 to 117
F. or T. 2-2, 5, 50 to 53, 56,
77 to 82
3-2 to 5, 18 to 39, 48, 86, 87,
88
F. or T. 3-1, 8 to 15, 17 to 19,
22 to 27, 30, 31, 32
6-5
F. or T. 6-1
8-6 to 34, 91 to 94
9-1, 7 to 10, 40, 58, 59
F. or T. 9-32, 38
10-1 to 46
F. or T. 10-1 to 32
12-1
13-17
F. or T. 13-5
14-3 to 8, 34 to 42
F. or T. 14-1 to 8
16-43
Engineering factors. 11-21 to 38
F. or T. 11-10 to 16
Engineering tasks F. or T. 10-8
Engines See also Rockets and Boosters
F. or T. 8-32
9-7, 53 to 57
F. or T. 9-3, 10, 50
Entrainment, rhythm 16-80, 81, 89
F. or T. 16-27 to 30
Envelope See Girdle
Environmental control system See also Backpack and Life
support system
11-20 to 38
F. or T. 11-10 to 16
Environmental factors. See also specific types
3-80, 85
F. or T. 3-65
13-2
F. or T. 13-1
Environmental temperature See also Atmospheric tempera-
ture
6-11
F. or T. 6-77, 79, 89, 101
Enzyme 2-116
F. or T. 11-8
13-10, 14
F. or T. 13-8, 18
Eosinophil 1-8
Epicycles 7-61

Epidermis	2-111 to 115 F. or T. 2-78, 79
Epigastrium	3-53 F. or T. 3-42 8-44 to 46
Epilation.	3-59 F. or T. 3-45
Epileptic seizures	9-48
Epinephrine	7-117, 126 F. or T. 7-78
Equilibrium, gas	12-6, 7
Equilibrium, postural.	See also Balance 7-67, 93 to 96, 105, 106 F. or T. 7-42
Equivalent exposure time	9-59
Equivalent residual dose (ERD).	3-63
Equivalent spinal frequency	7-203 F. or T. 7-81, 82
Ergogenic factors.	10-22
Ergometry.	10-7, 23 to 30 F. or T. 10-7, 18
Error	F. or T. 2-66 F. or T. 6-82, 84 to 86 7-49, 53, 54, 63, 104 to 106 F. or T. 7-29, 30, 31, 40 8-59 to 94 F. or T. 8-41 to 43, 45, 46 48 to 51 9-49 to 55 F. or T. 9-36 16-90 F. or T. 16-27
Erythema, skin	2-112 to 115, 120 F. or T. 2-79 3-9, 28, 46, 57 to 61 F. or T. 3-5, 45 to 51
Escape	F. or T. 13-1
Ester	F. or T. 13-15 to 18
Ethereal compound	13-26
Ether	F. or T. 13-15 to 18
Ethnic groups	F. or T. 6-60
Ethylene glycol	13-81 F. or T. 13-19
Euler angular displacement	7-96 to 101 F. or T. 7-58
Eustachian tube	F. or T. 9-2
EVA	See Extravehicular activity and Extravehicular task
Evaporation	See also Outgassing 3-31, 32 6-1, 5, 6, 7, 16, 32 to 52 66, 81, 89, 90, 107, 113 (cont)

Evaporation (cont). F. or T. 6-1, 3, 4, 10, 26 to
45, 49, 58, 61 to 63, 66
to 71, 78, 93
11-7
F. or T. 11-8
12-30 to 32
F. or T. 13-14
15-1, 6, 11, 16
F. or T. 15-2, 3, 5, 6
16-54

Evaporative capacity, maximum 6-38, 39, 41, 42, 43
F. or T. 6-33, 74, 78

Eversion F. or T. 16-12

Excitation energy or potential 3-10
F. or T. 3-7

Excretion 13-12

Excursion vehicles, lunar 2-109

Exercise See also Work and Movement
and Metabolic rate
6-33, 51, 68, 69, 91, 95, 98,
121
F. or T. 6-43, 49, 60 to 63,
67, 69, 73, 80, 81, 87,
90 to 93, 98, 101, 105
10-1 to 41, 53, 67, 75
F. or T. 10-1 to 32
F. or T. 11-8
12-3, 4, 6
F. or T. 12-2, 4
14-34 to 42
F. or T. 14-18, 20, 21, 35
to 44
16-69, 70

Exercise (tolerance) 7-115, 117 to 126, 133 to 190
F. or T. 7-63 to 66

Exercise (work). 15-1, 5 to 9, 11
F. or T. 15-4 to 6, 9, 10

Exhaustion 10-70
F. or T. 10-11

Expedition 16-75
F. or T. 16-26

Exploration 15-13
F. or T. 15-11

Explosion See also Blast
7-212 to 219
F. or T. 7-91

Explosive decompression F. or T. 11-16
12-1, 11 to 34
F. or T. 12-9 to 11, 13 to 19
16-55
F. or T. 16-23

Exponential degassing 12-8 to 10
F. or T. 12-8

Exposure duration. See also Duration and Tolerance and Performance
F. or T. 6-1, 68, 77 to 82, 84, 89, 92, 93, 101 to 108

Exposure limit and condition See also Dose factor and Tolerance
1-12 to 15
F. or T. 1-7, 8
9-59 to 82
13-1 to 9, 14 to 17, 80
F. or T. 13-1, 19 to 21

Exposure suits F. or T. 6-104, 105

Exposure time See Duration and Exposure limits

Extension 16-62, 65
F. or T. 16-12, 18, 19, 23, 24

External auditory canal 9-3, 5, 40
F. or T. 9-2

Extinguishment, fire 10-60
F. or T. 11-16
13-79

Extracellular volume 14-29, 36, 40

Extravehicular activity (task). 2-42, 58, 108 to 110
3-31, 44, 55, 56
6-52, 56
7-127, 132 to 176
F. or T. 7-65 to 67
10-7, 25 to 27, 63, 67
12-11, 12, 30
16-3, 16, 48 to 64
F. or T. 16-18 to 23

Extremity See also Limb and specific part
3-57, 67, 76, 116
F. or T. 6-72
7-39, 117, 119

Exudate F. or T. 15-2

Eye See also Lens and other parts of eye and Vision
1-8, 10
F. or T. 1-7, 15
2-1, 114 to 120
F. or T. 2-1
3-83
F. or T. 3-66
5-14 (cont)

Farm	9-51
Fast phase, nystagmus	7-102
Fasteners	7-174 to 176
Fasting	See Starvation
Fat	1-2, 4, 6, 7, 12
	F. or T. 1-2, 3, 4, 5, 10,
	11, 12, 13, 14
	5-3
	F. or T. 6-65
	8-34
	F. or T. 8-19
	10-1, 22
	F. or T. 10-1, 2, 4, 5
	F. or T. 11-2
	12-2, 14
	13-11
	F. or T. 13-4, 11, 12
	14-1, 3 to 8
	F. or T. 14-1, 2 to 6, 9, 11,
	13
	15-8, 9
	F. or T. 15-2, 7, 8
	16-21
	F. or T. 16-4
Fat content.	15-1
Fatigue	See also Exhaustion
	2-25, 26, 52, 74
	3-46, 51, 53, 66, 83
	F. or T. 42, 79
	6-33
	F. or T. 6-109
	7-6, 115, 118, 187
	8-1, 6, 36, 44 to 46, 78,
	85, 91
	F. or T. 8-20, 25, 31, 37
	9-42, 48, 53 to 55, 57
	F. or T. 9-36
	10-23, 24, 38 to 40, 69 to
	71, 75
	F. or T. 10-11
	13-15 to 17
	14-18, 35
	F. or T. 15-9
	16-38, 63, 81, 82, 83 to 86,
	94 to 96
Fatty acid	13-17
	F. or T. 13-4, 12, 13, 15
	to 18, 24
Fear	7-5, 82, 90
	9-49

Feces	6-1 8-35 F. or T. 8-20, 21 F. or T. 11-8 13-17, 92 F. or T. 13-3 to 5, 14, 15 14-9 F. or T. 14-14 15-1, 4, 6 F. or T. 15-1
Feedback (loops)	7-67, 79 F. or T. 7-36, 47 to 51 8-83, 85, 89, 90 11-8 16-43
Feeding	8-19
Feeding tube systems	14-14 to 17, 24, 29 F. or T. 14-8
Feet	2-112 3-61
Female	9-21, 42, 52
Femur	F. or T. 3-32
Feoktistov	7-131
Fermentation, intestinal.	14-8
Fertility	See also Testis 1-10
Fever	3-53, 55, 66 F. or T. 3-36, 43 F. or T. 6-40
Fiber content.	14-8, 9 F. or T. 14-9, 11, 13
Fiberglass	12-12
Fibrillation, heart	5-8, 9, 10, 11, 12, 14, 15, 19 F. or T. 5-3, 4, 5, 7
Fibrosis	3-59, 71
Field strength	5-1
Film temperature.	F. or T. 6-1, 23
Film thickness	F. or T. 6-1
Filters	2-19, 65 to 67, 78 to 81, 94, 108 to 110, 114, 116 F. or T. 2-81, 82 9-21, 31, 38, 39, 75, 80 13-91 F. or T. 13-1, 2
Finger.	See also Hand 5-6 F. or T. 5-1 6-125 F. or T. 6-22, 57, 94, 102, 106, 109, 172 (cont)

Finger (cont) 8-21, 22, 35, 46, 92
 F. or T. 8-15, 26, 27, 30
 9-48, 49, 53 to 55
 F. or T. 9-36
 F. or T. 12-27, 30
 F. or T. 13-10
 16-49, 63, 64
 F. or T. 16-4, 19 to 21, 23
 Finger (control) F. or T. 7-28, 29, 66
 Finishes (paints) F. or T. 2-10, 59
 Fire See also Extinguishment
 10-57 to 60
 F. or T. 10-42 to 45
 F. or T. 11-8, 16
 13-79, 80
 F. or T. 13-22
 Fixation See Bracing
 Fixation, hold. 7-166
 Fixation, gaze 2-99
 7-56, 81, 82, 91
 Flame See Fire
 Flash 2-32, 36 to 38, 58, 60 to 62,
 64, 65
 F. or T. 2-35, 50 to 54, 56,
 60
 Flash blindness 2-51, 58 to 68, 77, 108 to
 110
 F. or T. 2-50 to 56, 60
 F. or T. 11-16
 Flash rate See Intermittent light
 Flatus F. or T. 11-8, 16
 13-17
 F. or T. 13-5, 6, 14
 14-8
 Flavor See Organoleptic properties
 15-18
 Flexion 16-55, 62, 65
 F. or T. 16-4, 12, 18, 19,
 23, 24
 Flicker epilepsy 2-38
 Flicker fusion frequency 7-49
 Flight plans 7-153 to 158
 Floodlights 2-50, 78
 Floor 5-7
 F. or T. 5-2
 7-94, 110, 187, 212, 213 to
 219
 F. or T. 7-91, 92
 8-57
 F. or T. 16-16

Flow, gas 12-12 to 30
 F. or T. 12-9 to 19
 Flow-rate See Velocity, gas and
 Velocity, mass
 Fluorescent colors 2-31, 73
 Fluorine 13-79, 81, 82
 F. or T. 13-20
 Fluorohydrocarbons. 13-79
 F. or T. 13-15 to 18
 14-32
 F. or T. 14-15 to 17
 Fluorohydrocortisone 7-125
 F. or T. 7-61
 Flux, radiation. 3-1, 2, 3, 5, 18, 30 to 38,
 42, 44, 45, 86
 F. or T. 3-3, 16, 23, 25
 to 28, 32, 35
 Flux spectrum 3-1, 39, 82, 86
 Flux-to-dose conversion. 3-1, 31 to 33
 F. or T. 3-23 to 26
 Flying personnel See USAF, Astronauts, pilots
 F. or T. 16-3
 Foam cushion F. or T. 10-44
 Foamed garments (suits) 12-10
 16-54
 Foam tests. F. or T. 15-15
 Focal length and distance F. or T. 2-1
 Fog 9-10
 F. or T. 13-22
 Folic acid 14-2
 F. or T. 14-6
 Food See also Diet
 6-125
 F. or T. 6-89
 10-1, 6, 22, 55
 F. or T. 10-1, 2, 4, 5
 F. or T. 11-8
 F. or T. 13-3, 4, 14
 15-1, 5, 8, 9, 12
 F. or T. 15-2, 3, 6 to 8, 13
 Foods, fresh or specific 14-16 to 29
 F. or T. 14-8, 9 to 12
 Foot. 5-6, 7
 6-32, 59, 66, 73, 121
 F. or T. 6-26 to 29, 54, 57,
 58, 101 to 105, 106
 7-57, 105, 133 to 176, 183,
 215, 216, 220
 F. or T. 7-36, 63, 64 to 66,
 91, 92, 94 (cont)

Foot (cont) 8-31, 56, 60, 62 to 67, 78,
83
F. or T. 8-8, 39
16-26, 49
F. or T. 16-2 to 6, 8, 9, 11,
12

Foot candles F. or T. 2-3, 35

Foot controls 8-78, 83
F. or T. 8-39

Footholds 7-133 to 167
F. or T. 7-66

Footlamberts F. or T. 2-4, 5

Force 16-3, 16, 21, 36 to 65
F. or T. 16-6, 12 to 23

Forced expiratory capacity F. or T. 7-13

Fore-aft vibration See $\pm G_x$

Forehead F. or T. 13-11, 12

Formaldehyde 13-26

Formula diets 14-9

Fort Churchill F. or T. 15-4

Fourier analysis 8-7, 30

Foveal vision (thresholds) 2-20, 60, 64, 93, 96
F. or T. 2-1, 24, 38
F. or T. 7-20

Fractures 7-197, 216, 217
F. or T. 7-78, 91, 92, 94

Frame of reference 7-99
F. or T. 7-58

Free space 3-1, 31 to 33

Freeze dried food 14-17
F. or T. 14-8

Freezers 14-18

Freons 13-26, 80, 81
F. or T. 13-15 to 19

Frequency See also Wavelength
1-1, 4 to 17
F. or T. 1-1, 2, 3, 4, 5
F. or T. 2-2
5-2, 3, 4, 5, 11, 15, 16, 17
F. or T. 5-6, 7, 13
7-38, 49, 53, 74, 81 to 83,
192 to 195, 203, 212, 215,
216
F. or T. 7-51, 75, 76, 81,
86, 89, 93
9-1 to 82
F. or T. 9-1, 2 to 52
11-3, 8
F. or T. 11-8
16-16

Frequency, definition 8-1 to 3, 6 to 94
 F. or T. 8-1, 2, 4 to 51
 Frequency discrimination 9-12
 F. or T. 9-8
 Friction, coefficient 7-179 to 181, 187
 F. or T. 7-65, 70
 Frontal plane 7-73
 F. or T. 7-57
 Frostbite 6-64
 F. or T. 6-99, 102
 13-46, 53
 F. or T. 13-15
 Frozen food 14-18
 F. or T. 14-8
 Frustration 16-70, 77, 79
 Fuel See Rocket propellants
 Fuel cells 15-21 to 26
 F. or T. 15-17
 Fuel utilization 7-54
 Fumes 13-10, 86 to 91
 F. or T. 13-15, 22
 Fungi 15-20
 Fusion frequency 2-38
 F. or T. 2-13, 36
 4-2

G

$+G_x$ 7-4, 6, 11, 16 to 29, 35, 38,
 41, 46, 48, 49, 53, 57,
 199, 203
 F. or T. 7-1 to 4, 8 to 15,
 17, 21, 22, 24, 27, 28,
 29, 31, 34, 37, 79, 81
 to 83, 86
 10-49
 F. or T. 10-37 to 39
 16-49, 65
 $-G_x$ 7-21, 29, 35 to 39, 41, 44,
 49, 199, 203
 F. or T. 7-1, 3, 4, 12, 16,
 17, 23, 24, 27 to 31, 34,
 37, 79, 81, 83, 86
 $\pm G_x$ vibration 8-3, 17, 19 to 22, 31, 40 to
 45, 48, 62 to 67, 77 to 80,
 88, 90 to 94
 F. or T. 8-14, 20, 24, 25,
 28, 31, 38, 48, 49

$+G_y$ . . . . .	.7-4, 35 F. or T. 7-1, 4, 17, 37, 86
$-G_y$ . . . . .	.7-35 F. or T. 7-1, 4, 17, 37, 86
$\pm G_y$ vibration . . . . .	.8-3, 20, 31, 43 to 46, 72, 77, 80, 91, 93, 94 F. or T. 8-24, 25, 38
$+G_z$ . . . . .	.7-4, 6, 11 to 17, 19, 21, 39, 40, 41, 44, 46, 48, 49, 57, 199, 215 to 221 F. or T. 7-1 to 6, 17 to 26, 28, 29, 34, 37, 64, 80, 81, 86, 91 to 94
$-G_z$ . . . . .	.7-11, 16, 17, 21, 39, 57, 61, 199, 201 F. or T. 7-1, 3, 4, 7, 19, 24, 34, 37, 80, 83, 86
$\pm G_z$ vibration . . . . .	.8-3, 5 to 20, 23 to 31, 36 to 46, 48 to 94 F. or T. 8-3 to 12, 17, 18, 20 to 25, 28 to 51
Gagging . . . . .	.9-52 to 55 F. or T. 9-36
Gain, amplification . . . . .	.9-36 to 39
Gain constant . . . . .	.7-75
Gait . . . . .	.See also Locomotion and Walk and Run and Stride 7-19
Galactic light . . . . .	.F. or T. 2-6
Galactic radiation and beams . . . . .	.See Cosmic radiation
Gamma ray . . . . .	.3-4, 26, 45, 52, 53, 74, 81 F. or T. 3-1, 4, 63
Garment . . . . .	.See specific type and Clothing and Space suit
Gas. . . . .	.See also specific gas and Atmosphere and Contaminant 11-1 to 38 F. or T. 11-1 to 16 14-3 to 8, 14 F. or T. 14-2 to 6
Gas chromatographs . . . . .	.See also Chromatographs 11-39
Gas constant. . . . .	.6-41 F. or T. 6-1, 13
Gas flow. . . . .	.See also Velocity, gas 11-19, 20 F. or T. 11-9
Gasping . . . . .	.12-31
Gastric distress . . . . .	.14-35 F. or T. 14-7 15-11

Gastric juice See also Stomach
15-1
F. or T. 15-1

Gastrointestinal tract (function) 7-132, 199
9-48
13-10
F. or T. 13-15, 18
16-80

Gastrointestinal syndrome 3-46, 48, 51, 54, 73, 80
F. or T. 3-3, 32, 36, 37

Gegenschein F. or T. 2-8

Gelatin F. or T. 11-2

Gemini 2-8, 69 to 72, 98, 104, 105
F. or T. 2-58
3-45
F. or T. 3-27
6-49, 56
7-29, 56, 63, 64, 115 to 119,
126, 131, 133 to 158, 164
174
F. or T. 7-63, 66
10-24 to 26, 55, 63
F. or T. 10-21, 25, 41
12-12
13-2, 18
F. or T. 13-16, 26
F. or T. 14-20
16-16, 26, 38, 43, 48, 54,
63, 71, 83, 84, 93
F. or T. 16-14, 25

Gemini, Project 8-78

General Dynamics MRSS simulator 7-105 to 107

Generation, contaminants 13-4 to 9, 17 to 93
F. or T. 13-1

Genetics 3-68, 78, 79

Geomagnetically trapped radiation See Van Allen belts

Geomagnetic field. 4-1, 2
F. or T. 4-1

Geometry of exposure. 12-34, 35
F. or T. 12-20

Geometry, shielding 3-30 to 33, 48, 51

German 7-201

German Engineering Society 8-58
F. or T. 8-36

Germinal epithelium 3-7, 62, 63, 78, 79, 89
F. or T. 3-3, 52

Giddiness F. or T. 6-90

Gingivitis 15-13

Girdle. 8-5, 11
F. or T. 8-5, 12

Glare	2-51 to 58, 65 to 67, 74 to 77, 81, 89, 90, 94, 105, 109, 110
Glass	F. or T. 2-45 to 49, 55, 60 12-12
Glass blowers cataract	2-117
Glass fabric	F. or T. 6-44, 45
Glasses	See also Window and Filter 2-67, 116, 117, 120
Glenn	F. or T. 2-73, 82
Globe temperature	F. or T. 7-63
	See also Wet bulb-globe temperature (WBGT)
Glottis.	F. or T. 6-74
Gloves	12-16 to 30
	F. or T. 5-2
	F. or T. 6-94, 101, 106
	7-132 to 163, 168 to 176
	12-12, 30
	16-54 to 64
	F. or T. 16-9, 23
Glucose	F. or T. 11-8
	F. or T. 15-7
Glutens	F. or T. 16-3
Glycogen	10-22
	F. or T. 15-2
Glycols	F. or T. 13-15 to 18
Gonads	See Germinal epithelium
Grade	See slope
Gradient, acceleration	7-4, 11, 12, 107, 110
	F. or T. 7-64
Grammar	9-30
Gratings, optical	8-70, 72
Gravireceptors.	See Otolith organ
Gravity	See also specific type and Subgravity and Zero gravity
	6-32, 41, 47, 49
	F. or T. 6-1, 4, 37
	7-67 to 80, 83, 93, 94, 95, 100, 102, 106, 107, 110 to 190, 195 to 221
	F. or T. 7-1, 51, 57, 61 to 73, 77 to 94
	8-5
	10-25 to 41, 49
	F. or T. 10-20 to 30, 37, 38
Grayout	7-12, 17, 19, 39, 40, 131
	F. or T. 7-2, 6, 19, 25
Grease	13-80

Grimacing 9-40
 Grip 7-48
 F. or T. 7-65
 8-21, 78
 F. or T. 8-15, 30
 14-42
 F. or T. 16-4, 7, 12 to 15,
 19
 Grissom F. or T. 7-63
 Groin F. or T. 6-29
 13-92
 Ground See also Floor
 7-215
 Ground exposure 3-5, 89
 Ground personnel 9-5 to 11, 53 to 55, 76 to 82
 F. or T. 9-36
 Ground support 13-1
 Ground support systems and personnel 16-21, 92
 Ground vehicles. See Land vehicles
 Grounding 5-4 to 7
 F. or T. 5-6
 16-69 to 96
 Groups. F. or T. 13-8, 10, 13
 Growth rate 8-48
 G.S. R. 7-8, 12, 38, 46, 125
 G-suit F. or T. 7-5, 7, 9 to 11, 16,
 17, 19
 Gums 15-13
 Gusts 8-56 to 58, 75
 F. or T. 8-34

H

Haber's Law 13-12
 Habitability 2-73 to 78
 F. or T. 2-59, 60
 F. or T. 14-9
 16-70 to 79
 Habituation. 7-73, 74, 85, 93, 96, 102
 F. or T. 7-41, 47, 56, 57,
 61
 8-46, 83
 Hair 2-111, 112
 F. or T. 2-78
 F. or T. 6-53
 13-26
 F. or T. 13-9, 14
 Hair follicle 2-111
 F. or T. 2-78

Hair tonic 13-26
 Halides 13-80, 81
 F. or T. 13-15 to 18, 20
 Hallucinations 7-131
 10-69
 16-70, 78, 94
 Halogenated hydrocarbons 13-81, 92
 F. or T. 13-15 to 19
 Hammers, pneumatic 8-35, 56
 F. or T. 8-33, 34
 Hand 2-112
 3-61, 89
 5-4 to 9
 F. or T. 5-2
 6-59, 66, 73, 116
 F. or T. 6-22, 26 to 29, 54,
 58, 158
 7-48, 62, 105, 132, 133 to
 176, 183
 F. or T. 7-27 to 31, 36, 66,
 73
 8-3, 11, 21, 22, 56, 58, 78
 to 94
 F. or T. 8-8, 15, 30, 33, 39
 9-51, 53 to 55
 F. or T. 9-36
 16-36, 38, 49, 54 to 64, 94
 F. or T. 16-2 to 6, 9, 13 to
 16, 19 to 21, 23
 Hand grip and speed F. or T. 14-21
 Hand holds and rails 7-133 to 176
 F. or T. 7-65, 66
 16-36
 Hand steadiness test F. or T. 10-47
 Hand tools 7-127, 150, 173 to 176
 F. or T. 7-65, 66
 Handles 16-38
 F. or T. 16-13, 14
 Hand control See Control, hand
 Handwriting 7-132
 Hard suits See also Space suits
 11-20
 12-25, 27, 29
 F. or T. 12-19
 16-55
 F. or T. 16-11, 23
 Harmonics 7-81
 9-18, 39, 40, 54
 F. or T. 9-36

Harness See also Restraint
 7-8, 35, 195, 199, 211, 212,
 220, 221
 F. or T. 7-5, 7, 9, 10, 11,
 12, 16, 17
 8-5, 21, 40 to 46, 91 to 94
 F. or T. 8-22, 30, 50
 F. or T. 16-21
 Harvard Fitness Test 14-35, 40
 Hatches 7-133 to 176
 16-2, 26, 36, 48 to 64
 F. or T. 16-18 to 22
 Hazards F. or T. 7-66
 Haze 2-96, 108 to 110
 Head See also Brain
 3-89
 6-59, 66, 70, 73
 F. or T. 6-22, 26 to 29, 54,
 57, 90
 7-5, 8, 17, 39, 57, 64, 73,
 77 to 110, 123, 127 to
 133, 197, 203, 213, 215,
 220, 221
 F. or T. 7-37, 47 to 49, 52
 to 64, 78, 84, 86, 87, 90,
 91
 8-9, 11, 20, 22, 24 to 31, 40
 to 46, 70, 74, 75, 78, 92
 to 94
 F. or T. 8-3, 5, 6, 14, 17,
 18, 20, 23 to 25, 47, 50
 9-53 to 55, 57
 F. or T. 9-36
 F. or T. 13-10, 12
 16-3, 26, 49, 54 to 65
 F. or T. 16-2 to 6, 19, 23
 Head movement 2-38, 42, 72
 F. or T. 2-37
 Headache 1-11
 3-64, 83
 F. or T. 6-90
 7-17, 57
 F. or T. 7-87
 8-44
 F. or T. 8-25
 9-53 to 55, 57
 F. or T. 9-36
 10-24, 69, 70
 F. or T. 10-47
 F. or T. 11-8
 12-4
 F. or T. 13-15, 21

Headphones See Earphones
 Healing See Regeneration
 Hearing function 7-46
 8-35
 9-4, 5, 40
 F. or T. 9-2
 F. or T. 10-47
 11-8
 F. or T. 11-8
 12-31, 39
 F. or T. 12-20 to 23
 Hearing loss See also Deafness
 Heart 1-1, 8, 11
 F. or T. 1-1
 4-2, 3
 5-8 to 10, 14 to 16, 19, 20
 F. or T. 5-3 to 5, 7, 8
 6-95
 F. or T. 6-58, 89, 90 to 93
 7-4, 12, 56, 57, 115 to 125,
 191, 199, 213
 F. or T. 7-2, 32, 33, 63, 64,
 78, 87
 8-32, 34, 48
 9-48, 49
 F. or T. 9-36
 10-7, 22 to 26, 30, 66
 F. or T. 10-13, 18, 47
 12-4, 30 to 33, 40
 F. or T. 13-15
 14-35 to 42
 16-69, 80, 92, 94
 Heart rate 6-95
 F. or T. 6-58, 89, 90, 92
 7-12, 62, 115 to 125, 199
 F. or T. 7-32, 63, 64, 78,
 87
 10-22, 24 to 26, 30, 66, 71
 F. or T. 10-13, 18, 47
 12-33, 34
 14-35 to 42
 15-11
 F. or T. 15-9
 Heart reflex 7-57, 117 to 125, 199, 215
 F. or T. 7-63, 78
 Heat See also Thermal-factors and
 Energy
 1-2 to 13
 F. or T. 1-4, 6
 2-65 to 67, 81
 5-2, 3, 6 to 8, 12 (cont)

Heat (cont)	F. or T. 5-3, 4 10-15, 38, 40, 58, 66, 67 F. or T. 10-1, 29, 30, 43 15-5, 6 to 8, 11, 18, 20 F. or T. 15-5 to 7 16-71, 74
Heat balance	6-1, 5, 9, 91, 113 to 116 F. or T. 6-3
Heat capacity	See also Storage, heat 6-40, 64, 70, 91, 95 F. or T. 6-1, 13, 58, 64, 65 10-58, 66 F. or T. 10-43 to 45 11-25, 27, 31, 32 F. or T. 11-1, 6, 7, 16
Heat cramps	6-68
Heat debt	F. or T. 6-100, 102
Heat exhaustion	F. or T. 6-90
Heat leaks, cryogenic	11-25 to 31 F. or T. 11-16
Heat loss	6-107 to 127 F. or T. 6-98, 101 to 105
Heat of combustion	14-5 F. or T. 14-5
Heat of reaction	F. or T. 10-33
Heat production	See Metabolic rate
Heat pulse	6-107 F. or T. 6-97
Heat storage index	See also Storage, heat 6-95 to 98
Heat stress	7-16, 118, 119 9-51, 58 14-40 F. or T. 14-21
Heat stress indices	6-9 to 18, 81 to 98 F. or T. 6-12, 74 to 76
Heat stroke	6-103 F. or T. 6-73, 90, 91
Heat transfer coefficient	11-32 F. or T. 11-15, 16
Heat transfer, overall	See also specific type 6-1, 5, 25, 42 to 52, 60 to 71 F. or T. 6-1, 35 to 43, 47 to 51
Heaters, food	14-29 F. or T. 14-7, 8
Heating	8-34, 35
Heating methods	6-121 F. or T. 6-9, 101, 106

Heavy particles or nuclei See also Specific Particles
and Cosmic Radiation
3-18, 44, 83, 88
F. or T. 3-15 to 17, 23, 63

Hedonic scales 14-9, 18
F. or T. 14-9

Heel F. or T. 16-4, 8

Height See also Attitude and Target
size and Length
F. or T. 6-16, 17, 64
7-182, 183
F. or T. 7-73
10-5
F. or T. 10-3
F. or T. 14-1
F. or T. 16-2 to 4, 9 to 12

Helicopters 8-51

Helium 6-28, 32, 42 to 52, 56, 59
F. or T. 6-13, 14, 25, 39
to 44
9-31
10-59, 60
F. or T. 10-43 to 45
11-8, 19 to 39
F. or T. 11-1 to 5, 7, 11,
14 to 16, 89
12-2, 5, 8, 9, 25, 26, 33
F. or T. 12-1, 9, 10, 18
13-86

Helium nuclei. See Alpha particles

Helmet (faceplate). See also Visor
2-79 to 81
7-35, 39, 48, 215, 220, 221
F. or T. 7-7, 9, 10, 11, 16,
17, 19, 66, 77, 86, 90
8-40 to 46, 77, 92 to 94
F. or T. 8-24, 25
9-7, 9, 31, 35, 77 to 82
F. or T. 9-3, 50 to 52
10-60, 63
12-11, 27
14-15, 24
16-36, 38, 54 to 65
F. or T. 16-9, 21, 23, 24

Hematocrit. F. or T. 11-8

Hemoconcentration 7-115, 116
F. or T. 15-9

Hemoglobin See also Oxygen saturation
2-113
7-29(cont)

Hemoglobin (cont) F. or T. 11-8
 13-10
 16-94
 Hemoglobin saturation and dissociation 10-48
 F. or T. 10-35 to 38
 Hematological See Blood
 Hematological syndrome See also Hematopoietic
 lethality
 3-7, 46, 51, 53 to 56, 64
 to 66, 73, 80, 84
 F. or T. 3-3, 5, 36, 37, 39,
 43, 44, 53
 Hematopoietic (hemopoietic) lethality 3-7, 53 to 56, 64, 65, 80
 F. or T. 3-5, 36, 37, 39, 53
 Hematopoietic system (marrow). 3-7, 30, 31, 46, 53 to 56, 64,
 65, 80, 84, 89
 F. or T. 3-36, 37, 39, 43,
 44, 53
 7-115, 116
 Hemolytic anemia 10-55
 F. or T. 10-41
 F. or T. 11-8, 16
 Hemopoiesis See Marrow, Bone and
 Hematopoietic system
 Hemoptysis F. or T. 7-9
 Hemorrhage 3-53, 66
 F. or T. 3-36, 43, 44
 5-13
 7-17, 35, 39, 118, 199, 203
 F. or T. 7-19, 83
 8-34, 35
 12-29, 31, 40, 41
 F. or T. 15-2
 Hepatic See Liver
 Heterodyne clipping 9-39
 HF F. or T. 13-15 to 18, 20
 HHMU See Maneuvering devices
 High intensity fields 4-2, 3
 F. or T. 4-2
 High pressure gas storage 11-21 to 25
 F. or T. 11-10, 11
 Highway illumination 2-53
 Himalayas 10-22
 F. or T. 10-18
 Hinge points See also Joint
 16-21, 36
 F. or T. 16-4 to 7, 9, 12
 Hip (joint) See also Pelvis
 7-181, 183
 F. or T. 7-72, 84
 8-17, 20(cont)

Hip (joint) (cont) F. or T. 8-6, 8, 14
 F. or T. 16-2 to 4, 6, 12,
 19, 23

Hiroshima 3-73, 76

Hodgkin's Disease 3-76

Hog 7-201
 F. or T. 7-79, 80

Hole See Orifice

Homeostasis 7-16, 118
 13-9

Homes F. or T. 8-37

Honeycomb structure F. or T. 16-23

Hope project 16-71, 87 to 90
 F. or T. 16-25, 30

Horizon 7-94

Horizon sensors 16-38

Horizontal motion and sense 7-74 to 77, 83, 132
 F. or T. 7-43 to 46

Horizontal vibration See also Supine and
 Transverse and $\pm G_x$
 F. or T. 8-7

Hormones See also specific types
 7-199
 F. or T. 13-3

Hoses F. or T. 16-23

Hostility 16-70, 77 to 79

Hot climate See also specific climate
 F. or T. 6-90

Hue 2-31 to 33, 75 to 77

Human effluvia 13-17 to 26
 F. or T. 13-3 to 15

Humans 1-9 to 16

Humerus F. or T. 3-32

Humidity and control See also Vapor pressure,
 water
 6-6, 8, 10, 12, 16, 32 to 42,
 52 to 60, 81, 89, 98, 103,
 107, 112
 F. or T. 6-3, 4, 7 to 12, 34
 to 38, 41, 43, 49, 59, 60,
 61 to 63, 64, 66 to 71, 72,
 74, 78, 79, 81, 82, 84,
 87, 88, 91 to 93, 100
 9-10
 10-1, 46
 F. or T. 10-1, 34
 11-29, 30
 F. or T. 11-8, 15, 16
 12-26
 13-2, 92 (cont)

Humidity and control (cont) 14-14, 32, 40
F. or T. 14-7, 10, 15 to 17
15-4, 7, 8, 11, 12, 18
F. or T. 15-6

Hunger 16-80

Hydration 7-16
15-1

Hydraulic absorbers 7-221

Hydraulic fluid 13-79

Hydrazines 13-81
F. or T. 13-15 to 18, 20

Hydrides F. or T. 13-15 to 18

Hydrocarbons 13-26 to 71
F. or T. 13-12, 15 to 18

Hydrodynamic mass and drag 7-167, 168
F. or T. 7-68, 69

Hydrogen F. or T. 11-4
12-2
F. or T. 13-5
14-5
F. or T. 14-2

Hydrogen bonds 4-3

Hydrogen halides 13-80
F. or T. 13-15 to 20

Hydrogen nuclei See also Protons
F. or T. 3-6, 7, 16, 17
4-2, 4

Hydrogen peroxide 10-42 to 45
F. or T. 10-33

Hydrogen sulfide F. or T. 13-5, 6, 15 to 18

Hydrogen tankage 11-31

Hydrolysis 13-12
F. or T. 15-2

Hydroquinones 15-26

Hydrostatic (pressure) effects 7-4, 8, 11, 29, 57, 61, 110
to 176, 201
F. or T. 7-2, 5, 15, 64, 68,
81, 85
9-57

Hydroxycorticosteroids 7-126

Hydroxyproline 7-126

Hygiene See also Sanitation
13-91 to 93
F. or T. 15-11, 12
16-74, 76

Hyoscine 7-90

Hypercapnia See also Carbon dioxide
10-60 to 76
F. or T. 10-46 to 50

Hyperkinesis 9-57

Hyperoxia 10-24, 53, 55
 F. or T. 10-40
 12-2

Hypertension See Blood pressure

Hyperthermia F. or T. 3-36
 10-25

Hypertonia 9-57

Hyperventilation (hypocapnia) 6-40, 68, 75, 76, 78, 81
 8-48, 51
 10-46, 66
 F. or T. 10-34

Hypocapnia See Hyperventilation

Hypohydration See Dehydration

Hypotension 7-117 to 125, 197
 12-4, 34

Hypothalamus 10-66

Hypothermia F. or T. 3-36
 5-20
 6-113 to 116, 121
 F. or T. 6-72, 90, 101 to 113
 7-16
 10-25
 12-34

Hypoxia 2-46, 68
 6-8
 F. or T. 6-4
 7-12, 16, 57, 85, 118, 125,
 126
 10-22 to 25, 48 to 76
 F. or T. 10-18, 19, 35 to 45,
 49
 12-16, 29 to 34
 F. or T. 12-1, 12

I

Identification See also Detectability
 2-92 to 105

Idiosyncrasy 3-51
 13-14
 16-77

Ignition 10-59, 60
 F. or T. 10-44

Iliac crest 7-57
 F. or T. 7-33, 86
 F. or T. 16-4, 6

Illuminance 2-1, 8, 12, 60, 73 to 78, 85,
 93 to 103 (cont)

Illuminance (cont) F. or T. 2-2, 3, 5, 6, 8, 9,
 39, 40, 50, 51, 55, 59,
 60, 63, 65
 Illumination See also Luminance and
 Background luminance
 7-39, 46
 F. or T. 7-21, 65
 8-1, 70 to 78
 F. or T. 8-42
 16-86
 Illusion 7-82 to 96, 110, 131
 F. or T. 7-52 to 57, 62, 63,
 65
 16-70, 78
 Image retention time 2-106
 Immersion See Ocean
 Immersion suit F. or T. 6-104, 105
 Immobilization 16-80
 Immunity 7-212
 13-93
 Impact 7-4, 35, 110, 190 to 221
 F. or T. 7-65, 75 to 94
 8-2, 17, 21, 34, 93, 94
 F. or T. 8-3, 30
 12-11, 12
 Impairment, psychological See also Behavioral reaction
 16-71 to 79
 F. or T. 16-25, 26
 Impedance 5-3, 4
 F. or T. 5-1
 7-59, 191 to 195, 220, 221
 F. or T. 7-75
 8-6 to 34, 91 to 94
 F. or T. 8-3 to 19
 9-39
 Impulse See also Pulse form
 7-8, 201
 F. or T. 7-65, 76, 81
 12-22
 Impulse, sound and noise See also Blast overpressure
 9-61
 Incentive F. or T. 6-86
 Incidence, symptom 3-49, 51, 52 to 56, 63 to 80
 F. or T. 3-41 to 47, 60 to 62
 12-4 to 10
 F. or T. 12-2, 4, 5, 20 to 22
 Incline See Slope
 Incontinence 7-12
 Incus 9-40
 F. or T. 9-2
 Index of refraction See Refractive index
 Indexing bar 2-104
 Indoles F. or T. 13-5, 6, 15 to 18, 24

Industrial 13-1, 2, 15 to 17, 56, 79
 F. or T. 13-15, 21
 15-11
 Industrial noise 9-42, 48, 49, 58 to 76
 F. or T. 9-3, 10
 Industrial tasks F. or T. 10-5, 7
 16-86, 90
 Inelastic collision See also Star formation
 3-1, 10
 Inert gas See also Specific gas,
 diluent gas
 9-31
 10-58, 59, 65
 F. or T. 10-43 to 45
 11-1 to 39
 F. or T. 11-1 to 16
 12-1 to 15
 F. or T. 12-5 to 10, 18
 Inertia locks 7-221
 Inertial buffer zone 7-107
 Inertial resultant or force 7-19, 107
 F. or T. 7-1, 5, 7, 9, 10,
 11, 16, 17, 65
 Infarction 12-4, 29 to 35
 Infection 3-46, 53, 64, 66, 81
 F. or T. 3-43, 44
 5-13
 13-10, 92
 15-12, 13
 F. or T. 16-21
 Inflammation 3-59
 5-12, 13
 13-10
 Information 9-30 to 33, 35
 F. or T. 9-25 to 27
 Infra-audible sound 9-5 to 11, 52 to 55, 78
 F. or T. 9-36
 Infrared See also Radiation, thermal
 2-110, 112, 113, 116, 117,
 120
 Infrared spectroscopy 13-85
 Infusion, water F. or T. 15-2
 Ingestion See also Intake, food
 F. or T. 13-15
 Inhalation 13-1, 11, 16, 86 to 91
 F. or T. 13-15, 23
 Injury See specific type
 Injury, pathological 7-59, 194, 197, 201, 203 to
 221
 F. or T. 7-34, 78 to 81, 82,
 83, 86 to 94

Inlet temperature 6-60 to 70
 F. or T. 6-48, 49, 51
 Inorganic gases F. or T. 13-15 to 18
 Inorganic hydrides F. or T. 13-15 to 18
 Insensible water (loss). See also Evaporation and
 Skin
 F. or T. 6-4
 14-36
 F. or T. 14-14
 15-6
 F. or T. 15-1, 3, 5, 6
 Insomnia 1-11
 16-80
 Instantaneous threshold 2-46
 F. or T. 2-44
 Instrument display See also Display
 7-39, 54, 63, 91 to 96, 105,
 106, 124
 F. or T. 7-65
 8-1, 3, 70 to 94
 F. or T. 8-44 to 51
 Instrument (panel) 2-35, 36, 72, 75, 77, 81 to
 91
 F. or T. 2-32
 Instrument, lunar 16-48
 Insulation See also Clothing conduct-
 ance and insulation
 6-52, 53, 56
 F. or T. 6-44
 12-12
 13-26 to 71
 Insulation, cryogenic 11-25 to 31
 F. or T. 11-12, 13
 Intake, food See also Calories
 14-3 to 8 (cont)
 Intake, food (cont) F. or T. 14-2 to 6
 Integrated absorbed dose 3-50, 56
 Integrated harness 7-35, 220, 221
 F. or T. 7-16
 Integration, mental 7-38
 Intellectual skills See Mental function
 Intelligibility 9-3, 24 to 39
 F. or T. 9-18 to 31, 36
 Intensity See Luminous intensity
 9-1 to 82
 F. or T. 9-3 to 52
 Intensity of field. 4-1
 F. or T. 4-1
 Intercept 2-99 to 101
 F. or T. 2-72
 Interchanges, dietary 14-3 to 8
 F. or T. 14-2 to 6

Interferometry 13-85
 Interhalogen fuel 13-81
 F. or T. 13-20
 Intermittency, light. 2-32, 35 to 38, 98
 F. or T. 2-32, 34
 Intermittency, work See also Interruption, noise
 10-7
 Internal organs See Viscera
 International noise control 9-59
 Interpersonal differences (variation) See also Population factors
 and Anthropometry
 6-95
 F. or T. 8-4, 40
 9-11, 12, 21 to 23, 31, 35,
 40, 56, 58 to 75
 F. or T. 9-16, 17, 23, 36,
 38 to 49
 Interphone 9-82
 F. or T. 9-28
 Interplanetary field F. or T. 4-1
 Interplanetary flight 3-83
 Interruption, noise 9-25, 26, 40, 60 to 76
 F. or T. 9-19, 33 42 to 49
 Intestine (function). See also Gastrointestinal
 function and Gastrointestinal
 syndrome
 1-8
 3-42, 51
 F. or T. 3-3, 32
 8-17, 35
 F. or T. 8-13
 14-42
 15-1
 F. or T. 15-1, 2
 Intracranial pressure 8-17
 Inversion F. or T. 16-46
 Inversion illusion 7-127, 132
 F. or T. 7-63
 Inversion, thermal 9-10
 Ion, aerosol 13-91
 Ionic mobility 5-1
 Ionization 2-67
 3-18, 26, 27, 30, 88
 Ionizing radiation See Radiation, ionizing
 Ionizing radiation (synergism) 1-15, 16
 Iridocyclitis 3-28
 Iron 3-1
 F. or T. 3-16
 F. or T. 14-1, 6, 11, 13
 Irradiance 2-56 to 58, 108 to 110
 F. or T. 2-2, 47 to 49

K

Kaons	3-10 F. or T. 3-10
Keratin	See also Skin, and Nails, and Hair F. or T. 13-10
Keratitis	2-115 to 120 F. or T. 2-81 F. or T. 13-15
Keratoses	3-71
Ketone bodies	F. or T. 13-15 to 18 14-1, 29, 36 to 40
Ketosis	See Ketone bodies
Ketosteroid	F. or T. 11-8 16-69, 94
Kickoff velocity.	7-218 F. or T. 7-93
Kidney	See also Urine 1-8 F. or T. 1-2, 3 3-73 6-125 8-34, 35 F. or T. 8-19 10-57, 73 13-11 F. or T. 13-15, 18 15-1, 4, 7 to 9 F. or T. 15-1, 2, 5, 6 2-38
Kilometric candle	F. or T. 7-32
Kinematic form.	See also Proprioceptive function 7-83, 94, 106 F. or T. 7-63, 65
Kinesthetic	See Energy
Kinetic energy	13-4 to 9
Kinetics	3-63 to 67
Kinetics of injury and repair.	13-26
Kitchen (dining).	F. or T. 15-11, 12 16-74, 76
Klystrons	1-15
Kneading	14-15, 32
Knee	F. or T. 6-94 7-181, 183 F. or T. 7-72, 84, 91 8-11 F. or T. 8-6 10-37 (cont)

Knee (cont) 16-48, 49, 54 to 64
 F. or T. 16-2 to 6, 9, 11,
 12, 16, 19, 22, 23

Kneeling 7-183, 187
 16-48, 49
 F. or T. 16-19, 22

Knob 7-48
 F. or T. 7-27
 8-78, 79

Knuckles 16-64
 F. or T. 16-4, 7, 23

Komarov 7-132

Krypton 3-18
 F. or T. 3-15
 F. or T. 11-1, 2, 4, 5
 F. or T. 12-2, 18

L

Lab exposure See Ground exposure

Labor, physical F. or T. 8-36

Laboratories, space 16-37

Labyrinth defective subjects 7-94, 132

Labyrinth (system) See also Semicircular canals
 and Vestibular system
 7-62, 64 to 67, 77 to 110,
 127 to 133
 F. or T. 7-35 to 43, 47 to
 62

Laceration 7-212 to 221
 F. or T. 7-91, 94

Lacrimal gland 2-115

Lactic acid or lactate 10-22, 23, 25

Ladder 7-183
 F. or T. 7-73
 10-15
 F. or T. 10-14
 16-48

Laika F. or T. 7-63

Lamberts F. or T. 2-3 to 5

Laminate films 14-32
 F. or T. 14-17

Lamp See also Lighting
 2-73 to 75, 92, 94, 126
 F. or T. 2-8, 39

Land vehicles See also specific type
 8-1, 35, 56, 91, 92 (cont)

Land vehicles (cont) F. or T. 8-3, 32, 33, 35
9-11
F. or T. 9-3
F. or T. 16-25

Landing, lunar 2-105 to 108
16-43, 47
F. or T. 16-22

Landing, spacecraft 7-190, 191, 205 to 211, 216
F. or T. 7-63, 85 to 88

Landing task 7-166, 216

Landolt C ring tests 2-90, 105
F. or T. 2-15, 40
8-70

Langmuir equation 13-6

Language See also Words, and Vocab-
ulary, and Speech
9-81

Laplace transform 8-26

Lard F. or T. 11-2

Larmor theorem 4-2

Larynx F. or T. 16-4

Laser 2-66 to 68
F. or T. 2-56

Lassitude See also Lethargy
3-46, 49, 53, 83

Late effects 3-4, 5, 10, 28, 29, 30, 59,
63 to 89
F. or T. 3-2, 4

Latency (period). See also Response time and
Reaction time
2-112 to 114
3-28, 45, 46, 51, 53 to 55,
57 to 59, 62 to 80, 85
F. or T. 3-36, 40, 41, 43 to
45
6-68
9-40
F. or T. 10-40, 47
12-2, 30
F. or T. 12-2
F. or T. 13-1

Latent heat loss See Evaporation

Latent heat of vaporization 6-33, 40, 61
F. or T. 6-1, 93

Lateral acceleration See $\pm G$

Lateral vibration See $\pm G^y$

Latitude 3-1^y

Launch (operations) See also Liftoff
2-77
7-8, 53, 56
F. or T. 7-12 (cont)

Launch (operations) (cont) 9-1, 5 to 10, 53 to 55
 F. or T. 9-3 to 5, 36
 Launch tower 8-91
 Laundry F. or T. 15-11
 Law 9-60
 Lead 3-18
 F. or T. 3-15
 Lead-time constant 8-89, 90
 Leadership 16-78
 Leakage (gas) 11-19 to 21, 26, 27
 F. or T. 11-9
 12-11
 13-6 to 9, 15
 F. or T. 13-1
 14-14
 16-55
 F. or T. 16-23
 Lean body mass 15-1
 Leans illusion 7-96
 Learning 3-83
 9-50
 12-31
 16-43, 94, 96
 Left lateral G See +G
 Leg 5-9
 6-33, 57, 73
 F. or T. 6-45, 57, 105
 7-5, 8, 12, 21, 35, 39, 48,
 49, 57, 64, 123, 179 to
 190, 215, 216, 220
 F. or T. 7-70 to 73, 84,
 91 to 94
 8-40 to 46
 F. or T. 8-21, 22, 24, 25,
 16-26, 49
 F. or T. 16-2 to 6, 16, 17
 Legal factors 13-1
 Legibility 2-42
 LEM 3-87
 9-80
 10-40
 14-29
 15-5
 F. or T. 15-5
 16-48 to 64
 F. or T. 16-18 to 22
 Length 16-3, 16, 55
 F. or T. 16-2 to 6, 9, 11, 1
 18, 23

Lens (ocular) See also Cataracts
 1-8, 10
 2-1, 115, 116
 F. or T. 2-1
 3-28, 30, 67 to 70, 89
 F. or T. 3-56 to 58
 Leonov 7-132
 Let-go-current threshold 5-12, 13, 16 to 19
 F. or T. 5-3, 4, 9, 10
 Lethal dose See also Death
 13-4, 15
 Lethality See also specific type and
 Death and Survival
 3-7, 30, 46, 48, 49, 51,
 53, 55, 63, 73 to 76
 F. or T. 3-3, 36 to 39, 40,
 41, 43
 8-34, 35
 Letter See Alphanumeric symbol and
 reading
 Leukemia 3-68, 76 to 78, 80, 82, 85
 F. or T. 3-61, 64
 Leukocyte See also specific type
 1-8
 3-33, 55, 82
 Leukopenia 3-46, 54
 F. or T. 3-43
 Lever 7-48
 F. or T. 7-65
 Libido 3-62
 Life raft 2-31
 Life-shortening 3-68, 73 to 78, 80, 85
 F. or T. 3-61, 62
 Life support system See also Backpack and
 Environmental control sys-
 tem
 7-133 to 144
 10-25
 16-1, 48
 F. or T. 16-21 to 22
 Lifting F. or T. 16-15 to 17
 Liftoff See also Takeoff
 9-6 to 10
 F. or T. 9-3 to 5
 Light 2-1 to 120
 F. or T. 2-1 to 83
 9-50
 14-14
 16-86
 Lighting system See also Illumination and
 Luminance (cont)

Lighting system (cont) 2-73 to 79
 F. or T. 2-59, 60
 7-5, 90, 91, 154, 155, 189,
 F. or T. 7-65
 16-63, 86

Lightning 2-65

Limb. See also specific limb
 7-64, 94, 190
 8-16, 36, 48, 78
 F. or T. 8-21, 22, 23
 12-6, 31
 16-3 to 16, 74, 95
 F. or T. 16-4, 19

Limb darkening 2-12

Limits See Tolerance

Line separation tests 8-70

Linear energy transfer (LET). 3-4, 5, 9, 10, 18, 26 to 33,
 48, 53, 56, 58 to 60, 63,
 70, 74, 77 to 79, 85, 87,
 88
 F. or T. 3-1 to 3, 8, 13, 16,
 17, 19, 20, 47, 49

Linear sustained acceleration. 7-4 to 56, 59, 61, 64, 73 to
 77, 83, 85, 94, 106, 107,
 131, 217, 218
 F. or T. 7-1 to 31, 34, 37,
 81

Linear velocity 7-74, 83, 106
 F. or T. 7-48

Lip. 9-29, 35, 37
 F. or T. 9-24, 27, 30

Lipid. See also Fat
 F. or T. 7-63
 F. or T. 8-19
 F. or T. 11-8
 F. or T. 13-4, 11, 12, 13

Lipid peroxide 10-55

Liquid See also Water
 6-8

Liquid-cooled suits. See also Space suits
 6-62 to 70, 73, 81
 F. or T. 6-51 to 56
 15-7
 F. or T. 15-5
 16-48, 54, 55, 62
 F. or T. 16-23

Liquid cushion muffs. F. or T. 9-51

Liquid phase 13-5, 88
 F. or T. 13-2, 22

Listener factors. 9-29 to 31
 F. or T. 9-25, 26

Lithium azide	11-31
Lithium compounds (oxygen)	10-42 to 46
	F. or T. 10-33
Liver	1-8
	F. or T. 1-2
	3-73
	7-191, 213, 215
	8-34
	F. or T. 8-19
	10-57
	F. or T. 10-41
	13-11
	F. or T. 13-15, 18
Liver function tests	F. or T. 11-8
	14-36
Load, carriage	10-7, 15, 38
	F. or T. 10-2, 7, 8, 11, 13,
	14, 26
	F. or T. 16-10, 15 to 17,
	22
Localization	9-20
Location of target	F. or T. 2-25
Locking mechanisms	16-36, 37, 54
	F. or T. 16-21, 22
Locomotion	See also specific form
	7-167 to 190
	F. or T. 7-65, 70 to 73
	F. or T. 10-5
	12-31
	16-3, 16, 36, 37, 48 to 64
	F. or T. 16-18 to 22
Logistic factors	14-3 to 8
	F. or T. 14-2 to 6
Long duration mission	16-36, 37, 71, 74 to 77, 91,
	92, 96
	F. or T. 16-26
Longitudinal axis	See $\pm G_z$
Longitudinal vibration	See $\pm G_z$
Lope	7-179 to 190
	F. or T. 7-70
	10-37
Loudness	9-1, 12 to 17, 20, 40 to 49
	F. or T. 9-1, 9, 10, 26
Loudspeaker	9-30
Low altitude flight	8-56 to 58
Low frequency sound	9-5 to 10, 52 to 55, 78
	F. or T. 9-36
Low intensity fields	4-1, 2
Lower body negative pressure	7-119 to 125
Lubricants	13-26 to 71

Luciferin-luciferase system	15-21
Lumberjacks	10-22
	F. or T. 10-5
Lumens.	F. or T. 2-2, 3, 5
Luminance	2-1, 8, 11 to 15, 18, 28, 36,
	38, 46, 53, 57, 60 to 65,
	73 to 78, 88 to 90, 92, 93,
	96, 99, 100, 104, 108 to
	110
	F. or T. 2-2 to 11, 13, 15,
	18 to 24, 26, 27, 34, 36,
	38, 41, 42, 45, 46, 50,
	51, 53, 55, 59, 60, 64,
	65, 68
	7-46
	F. or T. 7-26, 65
	8-71 to 78
	F. or T. 8-42, 43
Luminance contrast (thresholds)	See Contrast (thresholds)
Luminance threshold (dark).	F. or T. 2-42 to 44
Luminosity curve	F. or T. 2-28, 29
Luminous efficiency	F. or T. 2-2
Luminous emittance	F. or T. 2-3
Luminous flux.	2-15, 18
	F. or T. 2-2
Luminous intensity	2-37, 57, 58, 60, 61, 73,
	74
	F. or T. 2-2, 3, 21, 48 to
	52
Lump	6-1
Lumped parameter model	8-2, 6, 7, 32
	F. or T. 8-3
Lumped parameter system	7-192
Lunar	See Moon and specific
	factor
Lunar base	F. or T. 3-27, 28
Lunar excursion module	See LEM
Lung	See also Respiratory tract
	and alveoli
	F. or T. 1-2
	7-19, 21, 57, 125, 191, 199,
	213, 215
	F. or T. 7-13
	8-17, 34, 35
	F. or T. 9-37
	10-22 to 25, 46 to 76
	F. or T. 10-34 to 50
	12-1, 2, 16 to 35, 40
	F. or T. 12-12 to 21
	13-10, 11, 16, 86 to 91
	F. or T. 13-15, 23 (cont)

Lung (cont) . . . . .	.15-8
	F. or T. 15-5
Lung volume . . . . .	.F. or T. 11-8
Lux . . . . .	.F. or T. 2-3
Lymphatic . . . . .	.3-59
Lymphatics . . . . .	.15-1
Lymphocyte . . . . .	.1-8
Lymphocyte (lymphoid tissue) . . . . .	.3-53 to 55
	F. or T. 3-36, 43, 44
Lymphosarcoma . . . . .	.3-76

M

Maceration15-12
Machine, sources . . . . .	.13-26 to 71
	F. or T. 13-16
Macula . . . . .	.F. or T. 2-1
Magnesium . . . . .	.F. or T. 3-6
	14-2
	F. or T. 14-6, 11, 13, 19
Magnetic fields . . . . .	.3-1
	4-1 to 4
	F. or T. 4-1, 2
Magnetic rigidity . . . . .	.See Rigidity
Magnetosphere . . . . .	.4-1
Magnetrons . . . . .	.1-15
Magnitude . . . . .	.See Visual magnitude
Maintainability . . . . .	.16-1, 48, 54 to 64
	F. or T. 16-19 to 23
Maintenance tasks . . . . .	.10-28
Malaise . . . . .	.7-82, 90
Malfunctions . . . . .	.13-79, 80, 91
	F. or T. 13-16
Malignancy . . . . .	.See Neoplastic disease
Malleus . . . . .	.9-40
	F. or T. 9-2
Malpighian layer . . . . .	.2-111 to 115
Man-machine system . . . . .	.7-64, 67
	F. or T. 7-36
	16-1, 16, 37 to 79
	F. or T. 16-12 to 25
Maneuvering devices . . . . .	.See also A. M. U.
	7-127, 133 to 147
	F. or T. 7-66
	12-12
	16-16, 38, 43
Manual skill and dexterity . . . . .	.See also specific skills
	6-125
	F. or T. 6-89, 111, 112

Manufacturer, sources	14-18 F. or T. 14-9, 10
Manufacturing	See Walking
Manufacturer, sources	14-18 F. or T. 14-9, 10
Manufacturing	13-1
Marching	See Walking
Maria	2-11 F. or T. 2-10
Markings	See also Alphanumeric symbols 2-18 to 20 F. or T. 2-20, 21, 22, 63 See also Hematopoietic system 3-48, 51, 53 to 59, 64, 65, 67, 78, 82 F. or T. 3-43, 44, 53, 66 13-11, 14 F. or T. 13-15, 18 F. or T. 2-10
Marrow	4-1 16-86 3-55 F. or T. 3-40
Marrow, bone	F. or T. 7-10, 14 F. or T. 9-28
Mars	9-1, 17 to 22, 24 to 40, 53 to 55, 58 to 82 F. or T. 9-11 to 15, 18 to 24, 29
Marshall Islands	See also Weight 3-26, 30 7-106, 158 to 166, 192, 212 F. or T. 63, 65, 67 8-2, 5, 6, 9, 11, 13, 16, 19, 21 to 23, 91 to 94 F. or T. 8-3, 4, 5, 9 to 11, 15, 16 12-21 16-3, 16 F. or T. 16-4, 5, 6, 23 11-32, 33 F. or T. 11-16
Mask	11-39 13-85 F. or T. 6-1, 38, 62 13-17, 26 to 71 F. or T. 13-1 See also Model, thermal 8-2, 6 to 9, 17 F. or T. 8-3 12-27
Masking, auditory	
Mass	
Mass flow rate	
Mass spectrometry	
Mass transfer coefficient	
Material, outgassing	
Material, selection	
Mathematical model	

Mattress	F. or T. 7-9
Maximal work	14-38
	F. or T. 14-20
Material	16-54 to 64
Maximum aerobic capacity	10-18 to 25, 38, 53, 67
	F. or T. 10-2, 11, 15 to 19,
	23
	14-38
	F. or T. 14-20
Maximum allowable concentration (MAC).	13-4
Maximum breathing capacity (MBC or MVV)	10-23 to 25
	F. or T. 10-18
	F. or T. 11-8
Maximum exposure, noise	9-58 to 76
	F. or T. 9-38 to 49
Maximum operating dose (MOD)	3-85
	F. or T. 3-66
Maximum V/A ratios	12-22 to 29
Maximum work	See also Maximum aerobic
	capacity
	10-67
Mayo Tank	F. or T. 7-5
McAdams rule	6-32
M. E. A.	3-82
Meal, size	14-8
Mean free path	3-18
	F. or T. 3-14
Measurement (dimensions)	F. or T. 16-15 to 23
Measurement, sound	9-3, 12, 14 to 17, 42, 57
	F. or T. 9-3, 10
Measurement, vibration	8-8, 22, 23
	F. or T. 8-16
Mechanical efficiency	14-35, 36
Mechanic	See Biomechanic
Mechanoreceptor	9-47
Meclizine	7-90
Mel	9-2, 17
Melanin	2-112 to 115
Melting.	F. or T. 14-10
Membrane	5-1, 2, 3, 12
Membrane effects	1-6, 7
Membrane electrodialysis	15-21
	F. or T. 15-17
Memory	2-99
	F. or T. 6-85, 88
	7-49
	F. or T. 10-35, 39
	16-43, 71, 95, 96
Meninges	5-12, 13
Mental depression	7-57

Mental function See also Performance
6-94, 98
7-49 to 56, 57
F. or T. 7-15, 56, 57, 78
8-72, 74
F. or T. 8-20, 25, 36, 39
9-53 to 55, 57
F. or T. 9-36
10-48, 53, 69, 70, 75
F. or T. 10-47
14-34, 38
F. or T. 14-21
F. or T. 15-9
16-71, 77 to 79, 87 to 96

Menus (cycles) 14-18
F. or T. 14-9, 10, 12

Mercury Program (spacecraft) 2-8, 72, 98, 117
F. or T. 2-75
7-29, 54, 115, 117, 205
F. or T. 7-5, 16, 63, 86
8-78
F. or T. 9-3, 10, 26
11-21
12-27
13-26
F. or T. 13-15, 16
16-26, 83
F. or T. 16-6, 25

Mercury vapor F. or T. 11-8
F. or T. 13-15 to 18

Merlon 12-11, 12

Mesons 3-10

Mesopic vision 2-38, 93, 98, 99
F. or T. 2-6

Messages 9-31 to 33
F. or T. 9-25, 26

Metabolic activity 3-64
8-36, 48, 49, 51
F. or T. 8-28
9-49

Metabolic rate See also Work and Exercise
6-5, 6, 7, 19, 39, 40, 41, 62,
65, 81, 89, 90, 92, 112 to 121
F. or T. 6-1 to 4, 35 to 37,
49, 50, 53, 55, 58, 59, 60,
67 to 70, 74, 76, 78, 92,
93, 98, 101 to 103
10-1 to 46
F. or T. 10-1 to 32, 48
14-3 to 8, 34 to 42
F. or T. 14-2 to 6
15-1, 4, 5, 7, 11
F. or T. 15-5, 7

Metabolic water . . . . .	.14-3 to 8 F. or T. 14-2 to 6, 14 15-3, 8 F. so T. 15-1 to 3, 7, 13
Metabolism . . . . .	.3-64 7-110, 126 F. or T. 7-36 8-36, 48, 49, 51 F. or T. 8-28 11-8, 19 F. or T. 11-8, 16 13-9 to 17, 49 14-1 to 42 F. or T. 14-2 to 6, 14, 19 16-80
Metal . . . . .	.13-11 F. or T. 13-3, 7 to 10, 15 to 18
Metal foil laminates . . . . .	.14-32
Metal fume fever . . . . .	.13-48 F. or T. 13-15
Metallic oxides	F. or T. 13-15 to 18
Metastases . . . . .	.3-71
Meteoroid. . . . .	.2-58, 65 11-19 F. or T. 11-16
Meteoroid garment. . . . .	.12-11, 12 16-48, 54, 55, 62, 63 F. or T. 16-22, 23
Meteorological factors . . . . .	.9-11 F. or T. 9-5
Meter candles	F. or T. 2-5
Methane	F. or T. 13-5, 6
Microbe . . . . .	.See also Bacteria and Viruses 13-91 to 93 F. or T. 13-14
Microbeam . . . . .	.3-26, 83, 88 F. or T. 3-63
Micrometeoroid . . . . .	.See Meteoroid
Micronucleus, gas . . . . .	.12-5
Microphone . . . . .	.9-31, 35 to 39 F. or T. 9-28, 30, 31
Microthermal effects . . . . .	.1-67
Microwave radiation . . . . .	.1-1 to 17 F. or T. 1-1 to 14
Microwave spectroscopy . . . . .	.13-85
Middle ear . . . . .	.8-33 9-3, 40, 54 F. or T. 9-2, 36
Midline tissue dose (MTD) . . . . .	.3-29, 51

Military	8-51, 56 F. or T. 8-30, 31, 33, 50, 51 9-41, 42, 47, 52, 56 13-1 F. or T. 13-21 15-13 F. or T. 15-4, 11
Military operation	16-74 to 77, 90 F. or T. 16-26
Military personnel	See also U. S. A. F. 10-19 F. or T. 10-5, 8, 17 16-3, 21 F. or T. 16-3, 5, 6 to 12, 17
Milk	F. or T. 15-2
Milky Way	2-8
Minerals	14-2, 3, 36 F. or T. 14-1, 6, 19
Mines	12-40
Minimum angle of resolution (MAR)	2-56, 57, 110
Minimum audible pressure (field)	F. or T. 9-6
Minimum (obligatory) water output	15-6 to 9 F. or T. 15-6, 7, 8
Minimum perceptible acuity	F. or T. 2-15
Missiles	7-197, 212 to 221 F. or T. 7-89 12-34
Mission	See also specific type 7-35, 53
Mistake	See Errors
Mixed contaminants	13-12, 13, 15
Mixed vibration	8-45
Mixing efficiency	6-32
MMH propellant	F. or T. 13-20
Mobility	7-132 F. or T. 7-65 8-19, 21 16-1, 16, 37 to 79 F. or T. 16-12 to 25
Model	7-77 to 82, 173, 191, 192 to 195, 201, 203, 215 F. or T. 7-43 to 51, 81, 82
Model, mathematical	16-16, 78
Model, thermal	6-7, 27, 28, 49, 57, 68 F. or T. 6-21, 22, 25
Modulation	9-39, 41
Moisture content	F. or T. 11-6, 7, 15
M. O. L.	See Orbiting laboratory
Molar unit	13-4
Molecular effect	F. or T. 3-6 4-2, 3 (cont)

Mouse (cont)	.8-19 F. or T. 8-13 9-47
Mouth	.6-107 8-17, 79 9-21, 35, 37 F. or T. 9-30 11-3 F. or T. 11-8 13-86 F. or T. 13-14, 15 15-1, 12
Mouth coolant	.15-12
Mouth temperature	.F. or T. 6-107
Movement, body	.12-30 16-36 to 65 F. or T. 16-12 to 24
Movement discrimination	.2-36, 38, 42, 57, 93 to 95, 97 to 109 F. or T. 2-13, 39, 73, 74, 76
Mucous	.13-86 F. or T. 13-14
Mucous membrane	.3-59 F. or T. 11-8 13-10, 11, 91, 92 F. or T. 13-14, 15, 18
Multiple myeloma	.3-76
Municipal water supply	.F. or T. 15-14 to 16
Munsell charts	.2-33
Muons	.3-10 F. or T. 3-10
Muscle	.3-10, 18, 27 F. or T. 3-6, 8 to 11, 14 5-3, 4, 7, 11, 13, 16, 17, 19, F. or T. 5-3, 4, 5, 9, 10 6-22, 95, 112 F. or T. 6-65, 104 9-40 10-22, 23, 48 12-2, 40 14-35, 38 15-11 F. or T. 15-9 16-43, 70, 94, 95 F. or T. 16-4
Muscle (activity)	.7-5, 12, 16, 19, 39, 48, 91, 117 to 125, 126, 191, 209 F. or T. 7-63, 78, 85 to 88 8-5, 32, 34, 44, 45, 48, 71, 78 F. or T. 8-20 to 22, 50

Muscle tissue 1-2 to 6, 11, 12
 F. or T. 1-2 to 4
 Musk-Ox, operation F. or T. 10-5
 Mutation 3-78, 79
 8-35
 Multiaxial rotation 7-63
 Mycoplasma 15-20
 Mylar 12-11

N

Nagasaki 3-73, 76
 Nails 13-26
 F. or T. 13-10, 14
 Narcosis See also Hyperoxia and
 Hypercapnia
 11-8
 12-2
 F. or T. 12-1
 13-11
 F. or T. 13-15
 NASA 7-102
 9-53 to 56, 78
 F. or T. 9-5, 52
 NAS-NRC 3-63, 64, 67, 74, 79, 87
 13-1 to 4, 56
 F. or T. 13-15, 16
 14-1, 2
 F. or T. 14-1
 15-16 to 26
 F. or T. 15-15, 16
 Natural frequency See Resonance and Natural
 period
 Natural period See also Resonance
 7-194, 216, 218
 F. or T. 7-62, 76, 93
 Nausea See also Vomiting
 3-46, 51, 53, 82
 F. or T. 36, 41 to 42
 F. or T. 6-79
 7-19, 57, 62, 82, 90, 96, 117,
 125, 127, 131
 F. or T. 7-55 to 57, 63, 65
 9-47, 52 to 55, 76
 F. or T. 9-36
 F. or T. 10-47, 73, 74
 F. or T. 13-21
 14-1, 35
 F. or T. 14-1
 Naval vessels 2-73

Navigation See also Celestial navigation
 16-43
 Navigation device See Instrument and Display
 Navy F. or T. 15-11
 Near vision F. or T. 7-24
 Nebulae F. or T. 2-8
 Neck
 6-107
 F. or T. 6-22, 57
 7-76 to 82, 94, 119, 125, 197,
 209
 F. or T. 7-49 to 51, 58, 86 to 88
 8-44, 45, 79
 F. or T. 8-21, 25
 16-54, 65
 F. or T. 16-2 to 6, 19, 23
 Neck seal 12-27, 28
 F. or T. 12-19
 Necrosis (late) of skin See also Ulcer, skin
 3-70 to 73
 F. or T. 3-59, 60
 Negative G See -G
 Negro skin 2-68, 111, 114
 F. or T. 2-78
 Neon 3-18, 30
 F. or T. 3-15, 17
 F. or T. 6-13
 11-8, 19 to 21, 23, 31, 34
 F. or T. 11-1, 2, 4, 6, 9, 11
 12-5, 32, 33
 F. or T. 12-18
 Neoplastic disease 3-52 68, 70 to 78,
 4-3
 Neoprene 12-12
 Nephro-agent See Kidney
 F. or T. 13-18
 Nerve activity 7-63, 67, 199
 F. or T. 7-35, 41, 63
 Nerves, peripheral 5-13
 F. or T. 13-18
 Nervous system 1-8, 11
 9-1, 58
 F. or T. 9-5
 Net seat 7-221
 F. or T. 7-5, 10
 Neurocirculatory collapse 12-4, 5, 31
 Neurological effects (syndrome) 3-46, 82, 83
 F. or T. 3-37
 4-2, 3
 8-36
 12-4, 5, 31

Neurological function 8-36

Neutral bouyancy See also Underwater simulation
10-28
F. or T. 10-20

Neutral zone See also Comfort
F. or T. 6-59, 60

Neutron 3-5, 18, 29 to 32, 44 to 46,
48, 59, 69, 70, 74, 77
F. or T. 3-4, 14, 22 to 24
61

Neutron, thermal 3-30, 45, 46
F. or T. 3-4

Neutrophilic leukocyte 3-55
F. or T. 3-36, 43

Niacin 14-2
F. or T. 14-1, 13

Nicholaev 7-131
F. or T. 7-63

Night See also Scotopic vision
2-28, 105
F. or T. 2-6
6-107
7-90, 154
F. or T. 9-37
F. or T. 13-6
15-11
F. or T. 15-10
16-49, 86 to 96

Night flight 7-90, 154

Night glow 2-92, 95
F. or T. 2-8, 71

Night vision. See scotopic vision

Nitriles F. or T. 13-15 to 18

Nitrogen F. or T. 3-6, 7, 16
6-22, 28, 41, 42 to 52
F. or T. 6-13, 14, 25, 34 to
37, 38 to 40, 42, 43
F. or T. 7-13, 63
10-46, 48, 57, 59, 60
F. or T. 10-34, 42, 43 to 45
11-8, 19 to 39
F. or T. 11-1 to 9, 11, 13 to 16
12-2, 7, 8, 9, 26, 32, 33
F. or T. 12-1, 5, 7, 9, 10, 18
16-94

Nitrogen balance 15-3, 4
F. or T. 15-7, 8

Nitrogen dioxide (NO₂) F. or T. 13-15 to 20

Nitrogen, metabolism 14-3, 36, 38
F. or T. 14-9

Nitrogen tetroxide (N_2O_4)	F. or T. 13-20
Nitrogen trifluoride (NF_3)	F. or T. 13-20
Nitrogen trioxide (NO_3)	F. or T. 13-20
Nitrogenous compounds	13-4
	F. or T. 13-3, 4, 6 to 8, 13, 15 to 20
Nits	F. or T. 2-4
Nodal points	F. or T. 2-1
	8-20
Nodding	7-97 to 110
	F. or T. 7-58 to 62
Noise	3-80, 81
	F. or T. 3-65
	8-1
	F. or T. 8-39
	9-1 to 82
	F. or T. 9-1 to 52
	16-71, 81
Noise cancelling system	9-26, 35 to 39, 53 to 55, 80
	F. or T. 9-30, 31
Noise control	9-42, 58 to 82
	F. or T. 9-50
Noise-induced permanent threshold shifts	9-3, 40 to 47, 58 to 76
(NIPTS)	F. or T. 9-33, 34, 38 to 49
Noise-induced temporary threshold shift	9-3, 40 to 47, 58 to 76
(NITTS)	F. or T. 9-33, 34, 38 to 49
Noise shield	9-35, 37, 53 to 55, 80
	F. or T. 9-30
Nomenclature	8-1 to 5
	13-4
Nomogram	F. or T. 8-2
	9-14
	F. or T. 9-3, 10
	10-48
	F. or T. 10-1 (cont)
	13-7
	F. or T. 14-2 to 6
Non-linearity	7-67, 77, 194, 209
	F. or T. 7-42 to 51, 85 to 88
	8-23 to 31, 62 to 67, 92
	F. or T. 8-11, 16, 17, 18, 83
Non-periodic vibration	See Random vibration
Nonsense syllables	9-30
	F. or T. 9-25, 27
Nonthermal effects	1-7, 8, 15
Norepinephrine	7-118, 126
Nose	F. or T. 8-20
	9-21, 53
	11-3
	F. or T. 11-8
	13-86 to 90 (cont)

Nose (cont)	F. or T. 13-14 to 16, 23 to 25
	F. or T. 16-4
Nova booster	F. or T. 9-3
Nuclear factors	13-86, 92
	F. or T. 13-1
Nuclear weapons	2-65, 71
	F. or T. 2-6
	3-2, 49, 52, 73, 76
	F. or T. 3-40
	F. or T. 6-95
Nuclei, aerosol	F. or T. 13-22
Nuclei, gas	12-4, 30
Nucleic acid	2-112
Nucleon	F. or T. 3-7, 16, 17, 19, 36
	to 42, 51
Nucleon density	F. or T. 3-7
Nude	6-47
	F. or T. 6-36, 37, 54, 68, 93,
	100, 104, 105, 109
	16-37, 49
	F. or T. 16-7
Null gravity	See Zero gravity
Number ranking	7-49
Numbness (index)	6-121
	F. or T. 6-107, 108
	7-57
Nusselt number	F. or T. 6-1
Nutrition	See Food and Diet
	2-46, 68
	13-14, 17
	F. or T. 13-3, 4
	14-1 to 42
	F. or T. 14-1 to 21
Nutritional requirements	14-1 to 3
Nylon	F. or T. 6-44, 45, 95
	7-35
	12-11, 12
Nystagmus	7-63, 67, 79, 85 to 94, 131 to
	133
	F. or T. 7-42, 48 to 57, 63
	9-48

O

Obligatory urine	See Urine
Observation	See also Search
	2-92
Observer-variation	2-88, 94
	F. or T. 2-25, 43

Obstacles . . . . .	.9-10, 11
Occipital cortex . . . . .	.2-1
Occupational exposure and protection . . . . .	.3-6, 79, 80, 89
Ocean. . . . .	.6-116 F. or T. 6-103 to 105
Octave (band) . . . . .	.9-2, 8 to 10, 14 to 16, 18 to 31, 41, 59 to 75 F. or T. 9-4, 5, 9, 10, 13 to 18, 26, 32, 38 to 49
Ocular motility . . . . .	.7-44 F. or T. 7-63
Ocular pursuit. . . . .	.2-38, 42
Ocular transmission . . . . .	.2-60
Oculographic tracing . . . . .	.7-67 16-93
Oculogravic illusion . . . . .	.7-73, 93, 94, 127, 131 F. or T. 7-63, 65
Oculogyral illusions . . . . .	.7-91, 93, 106 F. or T. 7-63
Oculomotor patterns	See Ocular pursuit, Ocular motility and Oculographic tracing
Odor . . . . .	.13-91 F. or T. 13-24, 25 F. or T. 15-14, 15, 17
Off-axis impact . . . . .	.7-197, 205 to 211 F. or T. 7-78, 86 to 88
Off-axis vibration . . . . .	.8-41 to 46, 75, 77 F. or T. 8-24, 25
Office (workers). . . . .	.6-15 F. or T. 6-10 F. or T. 9-26
Offgassing	See Outgassing
Ohm's law . . . . .	.5-3
Oil . . . . .	.13-26 to 71
Oil, olive	F. or T. 11-2
Oil/water solubility ratios	F. or T. 11-2
Olfactory sense . . . . .	.13-91 F. or T. 13-24, 25
Onset.	See Rate of onset
Opacity of lens	See Cataract
Operational constraints . . . . .	.14-14 F. or T. 14-7
Operative temperature . . . . .	.6-9, 10, 16, 33, 70 F. or T. 6-1, 5, 11, 47, 48, 56, 78
Opisthotonos . . . . .	.5-13
Optic axis	F. or T. 2-1
Optic disc . . . . .	.2-23 F. or T. 2-1, 25, 38
Optical enhancement . . . . .	.2-91

Optical properties See also Photometric units
and Photometry
2-65, 66, 78, 80, 81
F. or T. 2-61

Optical systems See also Eyes
8-32

Optimization factors, storage. 11-21 to 23
F. or T. 11-10, 11

Oral See Mouth

Orbit. See also Extravehicular
activity and Orbital flight
2-69 to 72, 82, 92, 93, 105,
106, 120
F. or T. 2-58
6-52
7-11, 29, 94, 106, 110 to 176
F. or T. 7-63
15-5
16-16, 26, 37, 49, 83 to 86,
87, 90 to 94
F. or T. 16-26

Orbit, lunar 2-105, 106, 120

Orbital flight See Space flight and
spacecraft and Orbit and
specific type

Orbital Maintenance 7-173 to 176

Orbital operations See also Zero gravity
10-25
F. or T. 10-31, 32
11-34
F. or T. 11-16

Orbital velocity 7-11
F. or T. 7-4, 48

Orbiting Laboratory 12-5
16-43

Organ 3-4, 6, 7, 30, 42, 89
7-213
F. or T. 7-94

Organ damage. 5-20
F. or T. 5-3 to 9

Organic contaminants, water 15-19, 25, 26
F. or T. 15-16, 17

Organoleptic properties See also Taste
14-9, 18
F. or T. 14-10, 14

Orientation 7-12, 19, 67, 77 to 110,
127 to 133, 209
F. or T. 7-47 to 51, 56 to
58, 61, 63, 65
F. or T. 10-47

Orientation, vehicle F. or T. 6-4

Orifice . . . . .	.12-13 to 15 F. or T. 12-9, 10 16-15 F. or T. 16-23
Oronasal passage . . . . .	.11-3
Orthogonal axes . . . . .	.7-1 F. or T. 7-1
Orthostatic intolerance . . . . .	.7-116 to 125 F. or T. 7-63, 64 10-66 11-8 14-36, 38 15-12
Oscillation, sinusoidal . . . . .	.See also Vibration 7-212 F. or T. 7-89
Oscillation, target . . . . .	.2-104
Osmoreceptors . . . . .	.7-116
Osmotic fragility . . . . .	.F. or T. 10-41 F. or T. 11-8
Osmotic (materials) pressure . . . . .	.15-6 to 9 F. or T. 15-6, 8
Ossicles, auditory . . . . .	.9-3, 40 F. or T. 9-2
Osteogenic sarcoma . . . . .	.3-77
Otolith organs . . . . .	.See also Utricle and saccule 7-64, 73 to 80, 83 F. or T. 7-35, 43 to 51, 57, 63, 65
Outgassing . . . . .	.13-17, 26, 79 F. or T. 13-16
Oval window . . . . .	.9-40 F. or T. 9-2
Ovaries . . . . .	.See Germinal epithelium
Oven . . . . .	.F. or T. 14-8
Overhydration . . . . .	.15-11, 13
Overpressure . . . . .	.See Blast
Overshoot . . . . .	.7-201 F. or T. 7-63, 81
Oxford index (W/D Index) . . . . .	.6-16, 95 F. or T. 6-12, 132
Oxidation . . . . .	.10-1, 55 13-12, 79
Oxidation, foods . . . . .	.14-2, 9
Oxidation water . . . . .	.See also Metabolic water 15-1, 8, 9 F. or T. 15-2, 7
Oxidative hemolytic anemia . . . . .	.10-55 F. or T. 10-8, 16
Oxides, inorganic . . . . .	.F. or T. 13-15 to 18, 20
Oxides, organic . . . . .	.F. or T. 13-15 to 18

Oxidizers See also Rocket propellants
F. or T. 13-15 to 18, 20

Oxygen See also Metabolic rate
3-64, 81
F. or T. 3-6, 7, 16, 65
6-18 to 52, 56
F. or T. 6-13, 14, 25, 34 to 43
7-12, 29, 41, 54, 116, 127
177 to 190
F. or T. 7-13 to 15, 22
8-19, 48, 49, 51
F. or T. 8-28
9-10
10-1 to 60
F. or T. 10-1 to 45, 49
11-1, 3, 8, 19, 20 to 39
F. or T. 11-4 to 10, 12
12-1, 2, 7, 8 to 16, 25 to
33, 40
F. or T. 12-1, 5 to 7, 9 to 11,
18
13-4, 10, 16, 17, 26, 92, 93
F. or T. 13-6, 15 to 18, 20
14-3 to 8, 32, 35 to 40
F. or T. 14-2 to 6, 20
15-3, 4, 11
F. or T. 15-5, 7
16-43, 48
F. or T. 16-21

Oxygen consumption See also Metabolic rate
7-177 to 190
F. or T. 7-13
F. or T. 11-8

Oxygen debt 6-98, 121
10-7, 15, 19, 25
F. or T. 10-2
14-35, 36, 38

Oxygen difluoride (OF_2) F. or T. 13-20

Oxygen pressure 10-22 to 25, 46 to 76
F. or T. 10-34 to 45, 48, 49

Oxygen pulse 14-38

Oxygen saturation, blood 7-29, 54
F. or T. 7-14, 15
10-48
F. or T. 11-8
12-1

Oxygen supply and storage 10-26, 38, 39, 42 to 46
F. or T. 10-5, 33

Oxygen toxicity See Hyperoxia

Ozone 2-110
F. or T. 13-15 to 18

Ozonides 10-42 to 46
F. or T. 10-33

P

P4SR . . . . .	. See Predicted 4 hour sweat rate
Pacemakers. . . . .	. 12-34
Pacing, work . . . . .	. 10-7, 28, 38
Pack, back . . . . .	. See back pack
Packaging, food . . . . .	. 14-3, 8, 14 to 18, 32, 34 F. or T. 14-15, 16, 17
Padding. . . . .	. 8-5, 23
Pain . . . . .	. 2-113, 115 5-13 F. or T. 5-3, 4 6-22, 107 F. or T. 6-58, 90, 94 to 97 107 7-5, 12, 19, 21, 39, 62, 209 F. or T. 7-32, 84, 86 to 88 8-16, 35, 36, 67 F. or T. 8-20, 22, 31, 35, 37 9-3, 41, 47, 51, 52, 57 F. or T. 9-32 10-53 12-2, 4, 30 13-10 14-35 16-63
Paint . . . . .	. See also Finishes F. or T. 2-10, 59 6-22 F. or T. 10-44, 45 13-26 to 71
Palatability . . . . .	. 14-9, 29 F. or T. 14-9, 10
Pallor . . . . .	. 7-62, 82, 117, 197 F. or T. 7-55, 57
Palm . . . . .	. 2-112 F. or T. 5-1 6-32 16-63 F. or T. 16-11, 19, 20
Pancreas . . . . .	. 15-1 F. or T. 15-1
Panel . . . . .	. See Display
Panel, NAS-NRC . . . . .	. See NAS-NRC
Pantothenic acid. . . . .	. 14-2 F. or T. 14-6
Pants . . . . .	. See Trousers
Paper . . . . .	. 10-60 F. or T. 10-44, 45
PAPP . . . . .	. 3-82

Parabolic flight 7-127, 133 to 176, 187
 F. or T. 7-7, 63, 65, 68
 10-28
 Parachute 2-31
 7-48, 190
 F. or T. 7-77
 Paradoxical sleep 16-92 to 94
 Parallax 2-95, 96, 104, 108
 F. or T. 2-15
 Paralysis 5-8, 9
 F. or T. 5-3, 4
 12-4, 31
 F. or T. 13-15
 Paramagnetic effects. 4-3
 Parasympathetic. See also Autonomic system
 10-74
 Paresthesias 7-12
 9-47
 F. or T. 10-47
 F. or T. 11-8
 12-4, 30
 Partial body radiation and shielding 3-42, 51
 Particle cutoff energy 3-39
 F. or T. 3-30, 31
 Particulates. 13-85 to 91
 F. or T. 13-22, 23
 Passive temperature controlled suits 6-68
 Pasteurization 15-18
 Path length 3-10
 F. or T. 3-8, 13
 Pathogens 13-91 to 93
 Pathological responses 8-5, 34, 35
 F. or T. 10-47
 13-4
 Patients 3-49, 52
 F. or T. 38, 40
 Pattern perception F. or T. 10-39
 Pattern tracing tests F. or T. 14-21, 113
 Peak acceleration 7-4, 8, 21, 190, 201, 203,
 205
 F. or T. 7-5, 7, 9, 10, 11,
 12, 16, 17, 31, 34, 42,
 55, 77, 81, 83
 8-2, 3 to 94
 F. or T. 8-1, 2, 6, 9, 11,
 14, 16, 20, 22 to 24, 28,
 29, 33, 34, 36 to 51
 Peak clipping See Clipping, speech
 Peak pressure See also Blast
 8-34
 Pearl chain effect 1-7

Pedal7-49
 F. or T. 16-16

Pegboard testF. or T. 6-111
 16-64
 F. or T. 16-23

PelvisSee also Hips
 3-6, 7
 8-13, 44, 45
 F. or T. 8-21, 25
 F. or T. 16-4

Penetration1-1, 4, 10
 F. or T. 3 to 6
 7-212
 F. or T. 7-94

Penetration factorSee also Depth and Depth
 dose
 3-7, 46, 56
 F. or T. 3-27

Penetration, ultraviolet2-110 to 115
 F. or T. 2-77 to 82

PentaboraneF. or T. 13-20

Percentile factors16-2
 F. or T. 16-1, 7, 8

PerceptionSee also Sensation
 5-11, 12
 F. or T. 5-4, 6
 7-38
 8-36 to 48, 58, 70
 F. or T. 8-20 to 23, 26, 27,
 30, 31, 35, 36
 9-3 to 5, 11 to 16
 F. or T. 9-6 to 9
 F. or T. 10-47
 16-68, 69, 93

Perceptual deprivation16-69, 78, 79

Perchlorates10-42 to 46
 F. or T. 10-33

PerformanceSee also Psychological effects
 and Behavior
 3-46, 63 to 67, 81, 84, 85
 6-81, 95, 98 to 101, 103,
 116 to 127
 F. or T. 6-77, 101 to 113
 7-17, 19, 38 to 56, 63, 82 to
 110, 127 to 176, 188
 F. or T. 7-31, 55 to 63, 65
 8-1, 36, 51, 56, 58, 67 to 94
 F. or T. 8-20, 31, 34, 36, 37,
 39 to 51
 9-2, 48, 49 to 55, 58 to 82
 F. or T. 9-36

Performance (cont) 10-23 to 41, 48, 49 to 53, 67
69, 70, 71, 75
F. or T. 10-4 to 19, 35 to 40,
47, 49
12-1, 2, 31
F. or T. 12-1
13-4
14-34 to 42
F. or T. 14-18 to 21
15-12
16-1 to 64, 70, 71, 78, 79,
81 to 96
F. or T. 16-30

Performance time See also Tolerance time
6-16, 95, 98 to 101, 103
F. or T. 6-79 to 88

Perimetry 16-54, 65

Perineum 3-61

Peripheral displays 2-91

Peripheral vision See also Grayout and Retina
and visual fields
7-12, 19, 39, 40, 106
F. or T. 7-6, 19, 25

Permeability, moisture 14-32
F. or T. 14-15 to 17

Permeability, oxygen 14-32
F. or T. 14-15 to 17

Peroxides 10-42 to 46
F. or T. 10-33

Personal protective equipment See also specific type pro-
tection
9-78 to 82

Personality 16-74, 77 to 79, 80

Perspiration See Sweat

Petechiae 7-6, 19, 21, 39, 62
F. or T. 7-32
12-31

Peters-Passmore Equation 15-3, 4

pH. 10-48, 72 to 75
14-14

Pharynx See Throat

Phase angle (lag) 2-11, 13
F. or T. 2-11
7-74 to 82, 192 to 195
F. or T. 7-42, 44, 45, 47 to
51, 75
8-8, 11, 13, 20, 28 to 32, 60,
62 to 67
F. or T. 8-9, 10

Phase shifts. 16-80 to 96
F. or T. 16-27 to 30

Phenols F. or T. 13-15 to 18
 Phenothiazine 7-90
 Phon 9-2, 12 to 17, 48
 F. or T. 9-1, 9, 10
 Phonation 11-8
 F. or T. 11-8
 Phonetics (balancing) 9-30
 F. or T. 9-25, 33
 Phorias F. or T. 11-8
 Phosgene F. or T. 13-15 to 19
 Phosphenes 4-2
 Phosphor 2-90
 Phosphorus F. or T. 3-6
 10-71, 73
 14-2, 29
 F. or T. 14-6, 11, 13
 Photallergy 2-115
 Photochemical 2-114 to 117
 Photography 2-13
 8-8
 Photometric units F. or T. 2-3 to 5
 Photometry 2-8
 Photophobia 2-115
 Photopic vision See also Visibility and Visual
 performance
 2-15, 93, 98, 99, 112
 F. or T. 2-6, 20, 24, 77
 Photoxicity 2-115
 Physical condition F. or T. 6-4
 12-6
 13-15
 Physical fitness See Training and Athletes
 Physical properties 11-19, 20
 Physiological response See also specific response
 8-5, 6, 35 to 67
 F. or T. 8-19 to 36
 9-40 to 49, 52 to 55, 59
 F. or T. 9-32 to 36
 13-9 to 17
 F. or T. 13-15 to 18
 Pig 9-51
 Pigment See also Melanin
 3-71
 Pile driver See also Hammer
 F. or T. 8-35
 Pilot 6-95
 7-63, 83, 90 to 96
 F. or T. 7-28, 34, 63, 65
 8-51, 57, 89, 90
 F. or T. 8-34, 50
 9-42 (cont)

Pilot (cont) 16-21, 83 to 85, 94
F. or T. 16-4, 6 to 8, 13, 15

Piloting task. See also Control dynamics
7-39, 53 to 56
F. or T. 7-28, 29, 31, 63, 65
10-40
F. or T. 10-8, 31

Pion 3-10
F. or T. 3-10

Pipe F. or T. 5-2

Piston 8-32, 77

Pitch (axis) 2-104
7-4, 59, 63, 211
F. or T. 7-1, 28, 29, 37, 48,
61, 87
16-38, 43
F. or T. 16-13, 14

Pitch, sound. 9-1, 12, 17, 35
F. or T. 9-1, 8

Pitressin 7-125

Pituitary (hormone) 1-8
3-76

Planck's constant. F. or T. 2-2

Plane See also Axes
16-49
F. or T. 16-18

Planet 2-8, 11
F. or T. 2-6, 10
6-9, 32
9-81, 82
10-48
13-93
16-64

Planning Operational Dose (POD) 3-85
F. or T. 3-66

Plant 4-1

Plasma (volume) 7-16, 115 to 125
F. or T. 7-64
10-55
F. or T. 10-41
F. or T. 11-3, 8
13-16
14-2, 36, 40
F. or T. 14-19
15-1

Plastic 2-78, 120
F. or T. 2-82
6-22, 53, 56
F. or T. 6-44, 45
F. or T. 10-44, 45
F. or T. 11-16
13-26, 79, 80
F. or T. 13-15 to 18

Plastic film . . . . .	.14-32 F. or T. 14-15 to 17
Plateau . . . . .	.7-8, 11, 12, 62, 197, 199, 201 F. or T. 7-4, 5, 7, 9 to 12, 16, 17, 78 to 81
Platelet. . . . .	.3-53 F. or T. 3-43, 44 F. or T. 7-78
Platform . . . . .	.See also Table, shake F. or T. 8-8
Plexiglas . . . . .	.2-78 F. or T. 2-61
PLSS . . . . .	.See Backpack and Life support system
Pneumonmediastinum . . . . .	.12-29
Pneumothorax . . . . .	.12-23, 28, 29, 31
POGO effect. . . . .	.2-72 8-90
Point source . . . . .	.2-8, 18, 57, 62, 93, 97, 98 F. or T. 2-18, 30, 48, 55
Polar coordinates . . . . .	.8-16, 17 F. or T. 8-11
Polarity convention . . . . .	.F. or T. 7-37
Polarization. . . . .	.1-15 F. or T. 1-10 to 14
Polarograph. . . . .	.11-34
Polishing tool . . . . .	.F. or T. 8-33
Polyamide . . . . .	.14-32 F. or T. 14-15 to 17
Polycarbonate . . . . .	.12-11
Polyester . . . . .	.F. or T. 6-44 14-32 F. or T. 14-15 to 17
Polyethylene . . . . .	.14-32 F. or T. 14-15 to 17
Polypropylene . . . . .	.14-32 F. or T. 14-15 to 17
Polysaccharide . . . . .	.15-1 F. or T. 15-7
Polytropic expansion. . . . .	.12-26 F. or T. 12-18
Polyvinyl chloride . . . . .	.14-32 F. or T. 14-15
Polyvinylidene chloride . . . . .	.14-32 F. or T. 14-15
Pooling, blood . . . . .	.7-39, 57, 62, 117 to 125
Popliteal height . . . . .	.F. or T. 16-3, 4
Popovich . . . . .	.7-131
Population factor. . . . .	.See also Interpersonal vari- ation and Observer variation F. or T. 9-34 (cont)

Population factor (cont) 16-1 to 64, 77 to 79, 81, 91,
92, 94 to 96
F. or T. 16-1 to 23

Pore 15-13

Pork F. or T. 13-6

Porphyrin 13-17
F. or T. 13-3

Portable life support system See Backpack

Position See Posture

Positive G See also +G_z
F. or T. 7-1

Positive pressure (breathing) (PPB) 7-8, 29, 119, 124, 125
F. or T. 7-5, 7, 9, 10, 16,
22
8-92

Posture (position). See also Backangle
6-19 to 25, 27, 39 to 41
F. or T. 6-4, 16 to 18, 44
7-5, 39 to 41, 44, 67, 85, 94,
117, 195
F. or T. 7-5, 7 to 11, 16, 17,
24, 36, 57, 63, 65, 68, 69
8-5, 8 to 46, 48
F. or T. 8-4 to 25
9-47, 50
12-34, 40
16-2, 16, 48 to 64
F. or T. 16-2, 3, 6 to 24

Potassium F. or T. 10-50
14-2, 29
F. or T. 14-6, 11, 13, 19
F. or T. 15-8
16-81

Potassium excretion 7-126

Potassium superoxide 10-42 to 46
F. or T. 10-33

Potency 3-62, 63

Potential difference See Voltage

Potentiation, toxic 13-13

Power 2-65 to 68
F. or T. 2-2, 56, 77, 81
F. or T. 6-106
9-39
F. or T. 9-50
F. or T. 13-1
14-8, 16 to 18, 29
F. or T. 14-8

Power density (spectrum) 1-10 to 13
F. or T. 1-7 to 9
7-194
8-3, 7, 22 to 30, 56 to 67,
83 to 85 (cont)

Power density (spectrum) (cont)	F. or T. 8-50 9-58
Power, electric	6-65 11-25 to 39 F. or T. 11-15, 16
Power, external work.	10-19 F. or T. 10-13, 20
Power penalties	10-42 to 46 11-32 to 38 F. or T. 11-15, 16
Power spectra	3-1, 39, 82, 86 9-21 to 24 F. or T. 9-16, 17
Prandtl number	6-3, 6, 28 F. or T. 6-1, 13
Pre-exposure light	2-46 to 56, 64, 88 to 90, 92, 97, 108 F. or T. 2-42, 44, 46, 66, 68
Precession, magnetic	4-2
Preconditioning (presoak)	F. or T. 13-1
Precooked food	14-18 F. or T. 14-9
Predicted 4 hour sweat rate (P4SR).	6-16, 90, 91, 95 F. or T. 6-76, 74 15-7 F. or T. 15-6
Preference, food.	F. or T. 14-9
Prehension	See also Grip F. or T. 16-21
Premature ventricular beat	F. or T. 7-86 12-34
Preoxygenation	See Denitrogenation
Presbycusis	See Age
Pressure	See also Intensity and Amplitude and specific pressure 7-5, 11, 12, 19, 21, 29, 39, 57, 64, 123, 124, 181 to 190, 205, 212 F. or T. 7-7, 14, 16, 19, 63 to 65, 68, 73, 85 8-19, 44 F. or T. 8-3 9-1, 2, 31, 81, 82 F. or T. 9-1 to 52 12-1 to 41 F. or T. 12-1 to 23 14-18, 24, 29 F. or T. 14-7 15-4, 5
Pressure, contact	F. or T. 5-1
Pressure, critical.	F. or T. 11-1

Pressure differential12-16 to 30
F. or T. 12-14 to 18

Pressure, gasSee also specific gas and
Barometric pressure
6-8, 28, 33, 36 to 52, 55,
81, 89
F. or T. 6-30 to 32, 34 to 41,
49, 50, 61 to 63, 66, 78

Pressure, partialSee also specific gas
10-1, 22 to 25, 46 to 76
F. or T. 10-1, 18
11-8, 19, 20
F. or T. 11-1, 6 to 10, 16
12-1, 2, 4, 16
F. or T. 12-1, 9, 10
13-4 to 6, 86
F. or T. 13-1, 23

Pressure ratio12-16 to 30
F. or T. 12-9, 10

Pressure suitSee Space suit, hard suit

Pressure, tankage11-21 to 31
F. or T. 11-10 to 13, 16

Pressure-variant storage.11-30

Pressurization, suitSee also Space suit
16-48, 54, 55, 62, 63
F. or T. 16-20 to 24

Price-Jones IndicesF. or T. 11-8

Prickly heat.15-13

Primary particleSee specific particle type

Primate.3-83
F. or T. 3-38

Prism8-74

Privacy.16-71 to 79

Probability3-49, 51 to 58, 63 to 80, 83,
85
F. or T. 3-38 to 42, 46 to 51,
56 to 62, 64

Problem solvingF. or T. 6-88
16-71

Prodrome3-7, 46, 49, 51 to 53, 82, 83
F. or T. 3-3, 5, 36, 41, 42

Progressive performance decrement3-9, 63 to 67

ProjectileSee Missile

Prolonged accelerationSee Linear sustained acceler-
ation

PronationF. or T. 16-12, 18, 19, 22

Prone2-5
F. or T. 7-16

Prone GSee also -G_x
F. or T. 7-1

Propagation9-1 to 3, 10, 11, 31, 34, 35, 58
F. or T. 9-5

Propellant	See also Rocket propellant F. or T. 7-66
Propeller	F. or T. 8-32, 33
Prophylactic therapy	3-82
Prophylaxis	7-90
Proportional control	7-53
Proprioceptor function	7-64, 76 to 83, 85, 106, 177 F. or T. 7-49 to 51, 56, 63, 65
Protective device	7-5, 35, 38, 190, 220, 221 F. or T. 7-5, 7 to 11, 16, 17, 18, 20 8-28, 91 to 94 F. or T. 8-30 9-5 to 10, 37, 40, 42, 47, 52, 58 to 82 F. or T. 9-29, 36, 38 to 52 12-7, 8 F. or T. 12-5 to 7
Protective equipment	16-1, 54 to 65
Protective glass	See also Filters 2-65, 66, 67, 109, 110, 116 F. or T. 2-81
Protein	2-112, 116 F. or T. 2-79 F. or T. 8-19 10-1, 22 F. or T. 13-4, 7, 8, 13 14-1 to 8, 29, 38 F. or T. 14-1 to 6, 9, 11, 13 F. or T. 16-2, 7, 8
Protein binding	11-19
Protein bound iodine (PBI)	8-51
Proton	3-2, 3, 10, 18 to 42, 48, 49, 53, 59, 69 to 71, 82, 87, 88 F. or T. 3-8 to 10, 13, 16 to 19, 21 to 30, 35, 63
Provitamin D	See Vitamin D
Pseudomonas	15-20
Psychochemical	13-11
Psychological effect	See also Behavior and Perfor- mance 3-62 4-2 6-4 7-1, 38 to 54, 63 to 110, 115 F. or T. 7-63, 65, 78
Psychological testing	See Performance
Psychomotor performance	See Performance and Psycho- logical effect and Behavior

Quality factor (QF) (cont)	F. or T. 3-1 to 4, 19 to 22, 39, 42 to 44, 47, 49
Quiet period	See Interruption, noise
Quiet sun period	3-3, 45

R

R_x	See also roll 7-4, 56, 61, 63, 64 F. or T. 7-1, 39, 57, 58
R_y	See also Pitch 7-4, 56 to 63 F. or T. 7-1, 32 to 34, 57, 58
R_z	See also Yaw 7-4, 62, 63, 91 to 96 F. or T. 7-1, 57, 58
Rabbit	2-116 9-47
Radar	1-9, 10, 15 F. or T. 1-1, 9 to 14 2-87 to 90, 97 F. or T. 2-66 to 68
Radiance	F. or T. 2-2
Radiant conductance and insulation.	6-20, 25, 52 to 56 F. or T. 6-15, 19, 44 12-12
Radiant flux (energy).	F. or T. 2-2
Radiant temperature	6-9, 19 to 25 F. or T. 6-15, 19, 20
Radiation	See specific type and ionizing radiation
Radiation Absorbed Dose (RAD)	3-4, 31 to 33 F. or T. 3-1, 23
Radiation area and factors	6-20 to 25, 49 F. or T. 6-1, 4, 16 to 20 16-26
Radiation, ionizing	3-1 to 89 F. or T. 3-1 to 66 F. or T. 6-4 7-16, 90 F. or T. 11-16 13-2, 92 14-14, 15
Radiation shielding	4-1
Radiation sickness syndrome	3-5 to 10, 45 to 86
Radiation sinks	6-9, 20, 22
Radiation, sound.	4-10
Radiation, thermal	6-1, 7 to 12, 18 to 25, 42 to 56, 59, 103, 107, 113 F. or T. 6-1 to 4, 15 to 20, 35 to 44, 78, 95, 97

Radiation yield 3-18
 Radiative insulation See Radiant conductance and
 Insulation
 Radio operation F. or T. 2-60
 Radioactivity 3-89
 F. or T. 15-14
 Radioisotopic thermal generators 3-45
 Radiologists 3-74, 76, 77
 Radium (226) 3-89
 F. or T. 3-11
 13-91
 Radius F. or T. 8-16, 19
 Radius of rotation 7-102 to 110
 F. or T. 7-55, 61 to 68
 16-3, 16
 F. or T. 16-5, 6
 Raft F. or T. 6-104
 Rales F. or T. 11-8
 Random noise (sound) 9-52 to 55
 F. or T. 9-30, 36
 Random vibration 8-3, 7, 23, 28, 46, 54, 56 to
 59, 61 to 67, 80, 83 to 85
 F. or T. 8-34, 35, 50
 Range See Visual range and specific
 type
 Range finder 2-110
 Range, locomotor 10-38, 39
 F. or T. 10-28 to 30
 Range, tissue 3-10, 18, 33 to 42
 F. or T. 3-10 to 13, 15, 29
 to 35
 Rapid decompression See Explosive decompression
 Rarefaction 9-2
 Raschel net 7-35
 Rat. 7-16, 190
 8-35
 F. or T. 13-20
 Rate damping task F. or T. 7-31
 Rate gyros 16-38
 Rate of decline See also Jolt and deceleration
 and Rate of onset
 7-1, 59
 Rate of onset See also Latency
 7-1, 35, 195, 199, 201, 203, 205,
 209, 212, 218, 220, 221
 F. or T. 7-5 to 12, 14, 76,
 78, 81 to 84, 93
 Rating, food 14-8, 9
 Rating system 8-56 to 59
 Rayon F. or T. 6-45
 Reach F. or T. 16-2, 3

Reactance	8-32
Reaction controls	7-56
Reaction time	6-125
	F. or T. 6-111
	7-41, 46, 63, 67, 74, 75
	F. or T. 7-39, 40, 63
	8-67, 77, 78
	F. or T. 8-39
	F. or T. 14-21
	F. or T. 16-27
Reading (task)	See also Alphanumeric symbols
	2-73, 82, 85, 86
	F. or T. 2-60, 62 to 65
	7-46
	8-70 to 77
	F. or T. 8-39, 42 to 46
	16-94
	F. or T. 16-27
Receptors, vibration	8-46 to 48
	F. or T. 8-26, 27
Reciprocating tasks	10-28, 30
	F. or T. 10-20, 26
Reciprocity law	2-58, 65, 109, 114
	F. or T. 2-50 to 53
	3-5
Reclining	8-3, 5
Recompression or repressurization	12-5, 10, 14, 15, 29 to 32,
	35, 39
Reconstitution, food	14-15, 29
	F. or T. 14-8, 10
Records.	3-65, 66
Recovery	See also specific type
	3-9, 51, 63 to 68
	6-107
	9-58 to 76
	F. or T. 9-42 to 49
Recovery, post work	10-7, 19
Recovery rate (time)	2-58, 60 to 62, 64
	F. or T. 2-50 to 54
	3-9, 51, 63 to 68
Recreation	16-79
Recreational lighting	F. or T. 2-60
Recruitment.	6-33
	F. or T. 6-26 to 28
Rectal temperature	6-19, 66, 68, 73, 95, 112 to
	116
	F. or T. 6-1, 4, 53, 59, 60,
	64, 68, 82, 89, 92, 102,
	104, 105, 107
	F. or T. 10-13
Rectangles	See Bars

Rectum	See also specific function F. or T. 8-21
Recycling, water	F. or T. 13-6 15-13 to 26
Red blood cell (mass and volume)	F. or T. 15-11, 12, 17 3-53 F. or T. 6-89 7-16, 115 to 125 10-55, 73 F. or T. 10-41, 50 F. or T. 11-3, 8, 16 14-36 F. or T. 14-19
Red light	F. or T. 7-27
Red-out	7-17, 39, 57 F. or T. 7-19, 32
Reduction, chemical.	13-12
Reduction, noise	See Attenuation
Redundancy.	See also Speech 9-81
Reentry	3-81 7-21, 29, 56, 118, 131 F. or T. 7-14, 30, 63 8-56, 89 F. or T. 8-30 9-9 15-5 14-40, 42
Refeeding, post-starvation	14-40, 42
Reference equivalent space exposure (RES).	3-6, 61, 65, 66, 70, 73, 77 78 F. or T. 3-53 to 55
Reference equivalent unit (REU)	See Reference equivalent space exposure (RES)
Reference operative temperature	6-16, 56 F. or T. 6-11, 45, 59, 78
Reflectance (reflection)	1-2, 4 2-8, 11, 12, 18, 68, 73 to 78, 110 F. or T. 2-2, 11, 59 6-9 F. or T. 6-58 8-32 9-9 to 11 12-34, 35 F. or T. 12-20, 21
Reflection, sound	9-9 to 11
Reflection, waves	12-34, 35 F. or T. 12-20, 21
Reflectivity coefficient	6-9
Reflex	7-91 F. or T. 7-63, 78

Refraction	2-24 F. or T. 2-1 9-10
Refractive errors	2-24
Refractive index	F. or T. 2-1
Refrigerants	13-26
Regeneration (healing and repair)	3-53, 59, 61, 71, 79 F. or T. 3-43
Regenerative systems	See Algae and Bacteria and Life support system
Region of body	See also Dose distribution 3-7 6-38 to 40, 59, 73 F. or T. 6-22, 26 to 29, 45, 53, 58
Rehabilitation	14-36, 38 F. or T. 14-19, 20
Rehydration	15-11, 12
Rehydration, food	14-15, 29, 34 F. or T. 14-7, 8, 10
Rejection	16-69
Relative biological effectiveness (RBE)	See also Quality factor (QF) 3-4, 26 to 30, 39, 44, 59, 60, 69, 70, 74 F. or T. 3-1, 4, 13, 17 to 21
Relative humidity	See also Humidity F. or T. 11-6, 7
Relative scotopic luminosity	F. or T. 2-2
Relaxation, postural	7-191 F. or T. 7-5 8-9, 11, 34 F. or T. 8-5, 9, 12 F. or T. 10-13 12-4 F. or T. 16-4
Relaxational process	9-10
Release time	9-37, 38
Reliability	11-34 F. or T. 11-16
Remote maneuvering units	2-105
Removal rate	13-5
Renal	See Urine and Kidney
Rendezvous	2-92, 96 to 105, 109, 110 F. or T. 2-72 to 74 16-43
Repair.	See Regeneration and Main- tenance tasks
Requirements	16-81, 82
Rescue	14-3
Resentment	16-70
Residual range, tissue	3-27 F. or T. 3-13

Resistance, body 13-92

Resistance, electrical F. or T. 1-2
5-1 to 9
F. or T. 5-1 to 3
16-69

Resistance, internal. F. or T. 5-2

Resistance, thermal. 6-25
F. or T. 6-1, 4

Resonance See also Natural period
7-59, 192 to 195
F. or T. 7-75, 76
8-6, 8 to 34, 46, 48, 54, 67,
71, 75, 78, 79, 88, 89,
91 to 94
F. or T. 8-3 to 19, 39, 41
9-7, 47, 53 to 55
F. or T. 9-36
11-8

Respiration (function) See also Inhalation, Respira-
tory tract and specific function
1-8
8-36, 44 to 46, 48, 49
F. or T. 8-20 to 22, 25, 28,
29, 31
9-48, 53 to 55
F. or T. 9-36
10-23, 24, 63, 69 to 73
F. or T. 10-1, 34, 47
F. or T. 11-8
12-4, 16 to 30, 31
13-1, 17, 86 to 91
F. or T. 13-15, 18, 22, 23
F. or T. 14-20
15-8
F. or T. 15-6, 9
16-69

Respiration (rate) 7-49, 57, 85, 110, 125, 199,
209
F. or T. 7-13, 63, 85 to 88

Respiratory center (arrest) 5-8, 11, 12

Respiratory heat and water loss 6-6, 7, 38 to 40, 81, 89
F. or T. 6-1, 2, 71

Respiratory muscles 5-11
F. or T. 5-5

Respiratory (pulmonary) minute volume 15-8
F. or T. 15-6, 9

Respiratory quotient (R.Q.) 8-48
10-22, 43 to 45
F. or T. 10-1, 33, 48
14-3 to 8, 36, 38
F. or T. 14-2 to 6, 19

Respiratory rate and depth	6-7, 39, 40, 81, 89 F. or T. 6-4, 71, 90 10-23, 24, 30, 46, 63 69 to 76 F. or T. 10-1, 47, 48
Respiratory tract	See also Lungs 8-17, 36, 48, 49, 79 F. or T. 8-28, 29, 31 10-23, 24, 53, 69 to 73 F. or T. 10-1, 34, 47, 50 13-14, 86 to 91, 93 F. or T. 13-15, 18, 22, 23 15-1, 3, 7, 8 F. or T. 15-1 to 3, 5, 6, 9, 13
Respiratory volume	10-23, 24, 63, 69 to 73 F. or T. 10-1, 34, 47
Respiratory work	10-7, 23, 24, 69, 70, 74
Response time	See also Duration of vision and Latency 2-87 to 90, 98 to 101 F. or T. 2-66 to 68, 73, 74 7-67, 74 to 76, 83, 91 F. or T. 7-27, 38 to 41, 46
Rest (periods)	See also Exercise and work and Metabolic rate F or T. 10-31, 32 12-4 to 7 F. or T. 12-4 16-26, 36, 81 to 90 F. or T. 16-30
Restlessness	F. or T. 6-9, 79, 90
Restraint (systems)	See also Cage restraints and specific type 7-5, 8, 35, 38, 133 to 164, 168 to 176, 195, 199, 201, 203, 205, 209, 211, 212, 220, 221 F. or T. 7-3, 5, 7, 9 to 11, 16 to 18, 63, 66, 83, 85 to 88 8-5, 21, 41 to 46, 75, 77, 78, 88, 91 to 94 F. or T. 8-50 10-24, 28, 30, 55 13-15 to 17 16-1, 2, 69 to 70 F. or T. 16-21 F. or T. 6-90, 105 2-99 F. or T. 11-8
Resuscitation	
Reticle	
Reticulocyte	

Retina	See also specific response 2-1, 18, 20, 23, 24, 36, 42, 46, 58, 60 to 62, 64, 65, 67, 74, 93, 95, 96, 116, 117 F. or T. 2-1, 13, 24, 25, 36, 37, 43, 55, 56 8-70 F. or T. 10-36
Retinal-aortic axis	See also Aortic-retinal angle 7-6, 8, 38, 39, 40 F. or T. 7-2
Retinal burn	2-64, 65, 117 F. or T. 2-56 3-70
Retinal luminance	F or T. 2-2
Retinal position	7-44, 133, 203 F or T. 7-25, 87
Retrieval	See Tether lines
Reverberation effects.	9-28 F or T. 9-22
Reversed rotation	7-96
Reynaud's phenomenon (syndrome).	8-35, 48 9-49
Reynolds number.	6-28, 36 F. or T. 6-1
Rhythmicity	10-7
Rib.	3-56 F. or T. 3-32 7-191 F. or T. 7-86 8-34, 44, 45 F. or T. 8-25 F. or T. 16-4
Riboflavin.	14-2 F. or T. 14-1, 6, 13
Ricco's law	2-8, 18
Rickets	2-112 F. or T. 2-79
Right lateral G	See also -G _y F. or T. 7-1
Rigidity	3-3, 29, 33, 38, 39, 42 F. or T. 3-21, 27 to 29, 34
Rim velocity.	7-107 F. or T. 7-62
Rise time	12-34 F. or T. 12-20 to 22
Risk-hazard analysis	3-1, 63 to 68, 77, 79, 80, 83 to 89
Riveting.	F. or T. 8-33
Road	See also Land vehicles F. or T. 8-33, 35

Rocket, booster and control	8-1, 89, 91
Rocket motor	7-95
Rocket noise	9-1, 5, 7, 17, 53 to 56, 76 to 82 F. or T. 9-3 to 5, 10, 36
Rocket propellants (fuels).	13-1, 81, 82 F. or T. 13-19, 20
Rod diets	14-24 F. or T. 14-13, 14
Rod, eye	2-1, 15, 23, 42, 46 F. or T. 2-35, 42, 43
Rodents	9-48
Roentgen (r).	3-4 F. or T. 3-1
Roentgen equivalent man (REM)	3-31 to 33, 89 F. or T. 3-1, 23, 24, 26
Roll	See also $\pm G_y$ and $\pm R_x$ 2-104 7-63, 67, 98 to 101, 132 F. or T. 7-1, 28, 29, 37, 39, 48, 58, 59, 60, 87 16-38, 47 F. or T. 16-13, 14
Rotary acceleration	See also Angular acceleration and specific axis 7-56 to 110 F. or T. 7-1, 35 to 43, 47 to 63, 65
Rotary movement	F. or T. 10-20
Rotary oscillation	8-46, 51, 75, 77
Rotary pursuit task	7-107
Rotating rooms and space stations	See also Counterrotation 7-85, 96 to 110, 131 F. or T. 7-55, 56, 58 to 62
Rotation	16-16, 36, 38, 62 F. or T. 16-6, 12, 18, 19, 23
Route	13-11, 12, 15
Rubber	13-81
Rubbing.	8-44, 45 F. or T. 8-25
Rudder pedal	7-49
Running	6-98, 121 7-179 to 190 F. or T. 7-70 to 73 10-18, 22, 36, 37 F. or T. 10-10, 11
Rupture, eardrum	9-47
RX suits	See Hard suits

S

Saccule	7-64, 67 to 78 F. or T. 7-43 to 51
Sacroiliac strain	8-44 F. or T. 8-21, 23
Safe	See Tolerance
Safe distance	F. or T. 1-9
Safety	See also Risk-hazard analysis 5-20 F. or T. 5-2 F. or T. 6-77 9-42 F. or T. 9-4, 5 13-15, 16 F. or T. 14-7 16-1, 36, 48 to 64 F. or T. 16-18 to 23
Safety handbook	3-89
Sagittal plane	7-73 F. or T. 7-48, 57
Sale	6-32 F. or T. 6-28
Salivary glands (saliva)	7-82 F. or T. 7-55 F. or T. 9-36 13-26 F. or T. 13-8, 14 15-1 F. or T. 15-1, 2
Salt	See also Electrolyte and Sodium F. or T. 6-90, 91 15-8, 9, 11, 12 F. or T. 15-8 16-80
Salt excretion	16-80
Sampling	13-79, 85 16-2 F. or T. 16-1
Sand dunes	10-15 F. or T. 10-13
Sanitation	See also Waste and Hygiene 15-6, 13 to 26 F. or T. 15-11 to 17
Satellites	2-8, 11, 20, 92 to 101
Saturation, gas.	12-9
Saturation, color	2-33

Saturn booster	8-90 9-7, 9 F. or T. 9-3 to 5, 36
Scala tympani and vestibuli	F. or T. 9-2
Scale	F. or T. 2-62
Scale reading.	See Dial reading
Scaling (law)	7-215 9-47 12-34, 35 F. or T. 12-21
Scaling, skin.	2-68
Scalp	3-61 8-71 F. or T. 8-20 F. or T. 13-8, 12
Scanning.	7-39, 82 to 85
Scapula	F. or T. 7-86
Scattering (function)	2-110, 111 3-44
Scheduling, work-rest-sleep	16-81 to 92 F. or T. 16-30
Schirra	F. or T. 7-63
Sciatic pain	7-197
Sclera	F. or T. 2-1
Scopolamine	7-90
Scotoma.	2-58 F. or T. 10-38
Scotomatic glare	See Flash blindness
Scotopic vision	2-20, 24, 28, 38, 42, 46, 89, 90, 93 F. or T. 2-6, 41, 77 F. or T. 10-35 F. or T. 11-8
Scratching	13-10
Sea	See also Ocean 2-28, 73, 87 8-56 F. or T. 15-10
Sea lab	F. or T. 13-16
Sea level equivalent	6-33, 51, 81 F. or T. 6-3, 6, 30, 43, 57, 101, 108, 111 F. or T. 12-1, 20, 21
Sea water	See Ocean
Seal, space suit	12-27, 28 F. or T. 12-19
Sealed cabin	See Space cabin
Sealing technology	11-19, 20 14-15, 32 16-54 to 64 F. or T. 16-22, 23

Search and rescue	2-25 to 28, 38, 87 to 94, 98, 99 F. or T. 2-66 to 68 8-56
Seat	7-5, 19, 35, 93, 94, 195 F. or T. 7-5, 7, 9 to 11, 16, 17, 79 to 88, 92 8-3, 5, 11, 13, 16, 48, 91 to 94 F. or T. 8-5, 22, 28, 50 16-21, 26, 49, 64, 74 F. or T. 16-4, 7, 8, 10, 21, 23
Seat angle	7-209 F. or T. 7-2, 5, 7, 9 to 11, 16, 17, 22, 86 to 88
Sebum	13-26 F. or T. 13-11, 14
Secondary particles	3-10, 18, 26, 31, 33, 44, 45, 48 F. or T. 3-2
Secretion rate	F. or T. 13-13
Selection, astronaut	7-96 12-29
Selenium rectifiers	13-79
Self shielding	See Shielding, body or tissue
Semen	13-26 F. or T. 13-14
Semicircular canals	See also Labyrinth 7-64 to 73, 77 to 110, 127 to 133 F. or T. 7-35 to 43, 47 to 49, 52 to 57
Semi-supine position	7-35 F. or T. 7-11, 12, 16, 75 8-13, 16, 19, 41 to 46 F. or T. 8-10, 13, 24
Semisolid food	14-24 F. or T. 14-13, 14
Sensation	6-121, 125 F. or T. 6-94 to 96, 99, 112 7-63, 64, 66, 67 to 82 F. or T. 7-15, 39, 43 to 51, 55 to 57, 63, 65
Sensible heat loss	See also specific type and Convection and Conduction F. or T. 15-5
Sensible water loss	14-36, 38

Sensitivity	F. or T. 5-4 8-25, 28, 46, 48 F. or T. 8-26, 27 9-11 to 14, 16, 24, 47 F. or T. 9-2, 6 to 9, 18
Sensitization	13-14, 15
Sensors, gas	2-110 11-34, 39
Sensory checking	16-95
Sensory deprivation	16-69, 78, 79
Sentences	9-30 to 33 F. or T. 9-27
Serotonin	3-82
Serum	F. or T. 8-19 F. or T. 11-2
Servomotor system	See also Feedback loops 8-83, 85, 89, 90, 92
Sex	13-12
Shadow	2-74, 109, 110 F. or T. 6-4
Shape, Emissivity factor	6-20 to 25 F. or T. 6-1
Shape factors	2-18 to 20, 46, 50, 53, 57, 58, 87, 94, 95, 100, 101 F. or T. 2-13, 20 to 22, 47 to 49, 72
Shaving	F. or T. 13-8, 14
Shear (wave).	7-59, 73, 77, 191, 197, 213 F. or T. 7-43, 74, 89 8-7, 32 to 34, 41 F. or T. 8-19
Sheep	F. or T. 5-7
Shielding, body or tissue	3-1, 27, 30, 33 to 42, 55, 56, 70 F. or T. 3-29
Shielding, vehicle	3-1, 9, 26, 27, 30, 31, 33 to 42, 55, 56, 70, 74, 81, 83 to 88 F. or T. 3-27, 32 to 35
Ship	See also Boats F. or T. 16-26
Shirtsleeve, clothing	See also Clothing and Underwear 7-167 F. or T. 16-9
Shivering	6-6, 7, 19, 68, 112 F. or T. 6-55, 107 10-74
Shock, electric	5-7 to 9, 19
Shock (mechanical)	See also Explosion and Impact and Blast 2-67 12-4, 40

Shock, physiological	7-197, 201, 203 F. or T. 7-83
Shoes	3-57, 166 F. or T. 5-2 16-54 to 65 F. or T. 16-2, 22, 23
Shoulder	7-183 F. or T. 7-58, 84, 86 8-20 to 22, 79, 91 F. or T. 8-6, 14 16-49 F. or T. 16-2 to 6, 7, 9, 11, 12, 16, 19, 23
Shouting	F. or T. 9-17, 26
Sidearm controller	F. or T. 7-3, 28 to 31 16-38, 48 F. or T. 16-13, 14
Sighting	2-78
Sign	3-8, 43 to 63 F. or T. 3-36
Signal light	2-32, 35 to 38, 77, 78, 98 F. or T. 2-32
Signal/noise ratio	2-90 F. or T. 2-70 9-1, 17, 18, 20, 30, 31, 35 to 39, 50, 51, 81, 82 F. or T. 9-11, 27, 33
Silastic	12-12
Silicones	13-79
Silver	3-88
Simulator	2-101 to 105 7-102 to 110, 133 to 190 F. or T. 7-63, 65, 68, 69, 92 10-25 to 46 13-79 F. or T. 13-16 14-18 15-5, 13 16-43, 70 to 79, 87 to 90, 95 F. or T. 16-25, 26, 30
Simultaneous speech	9-31
Singapore	6-91
Single side band	9-39
Sinus, nasal	F. or T. 7-19, 42
Sinusoidal (sine wave)	See also Vibration 8-2, 3 F. or T. 8-1, 2, 3

Siren	9-52
	F. or T. 9-5, 10
Sitting (position)	See also Seat
	7-192, 199 to 211
	F. or T. 7-69, 75, 79 to 88, 92 to 94
	8-3, 5, 9 to 12, 17, 19 to 21, 36, 40 to 46, 48 to 94
	F. or T. 8-4 to 7, 13, 14, 20 to 25, 28 to 51
	16-48, 49
	F. or T. 16-2 to 4, 6 to 9, 11, 19, 21 to 25
Size	See specific dimensions and Anthropometry
Size, particle	13-85 to 91
	F. or T. 13-22, 23
Skeleton	7-4, 191, 209
	F. or T. 7-63, 85 to 88
	F. or T. 8-21, 22
	12-41
	16-69
Skid, aircraft	7-95
Skiing	F. or T. 10-7
Skills	See also specific type and Performance
	16-43
Skin	1-4, 6
	F. or T. 1-2, 3, 5, 6
	2-66, 68, 110 to 115
	F. or T. 2-78, 79
	3-7, 9, 31, 46, 57 to 62, 68, 70 to 73, 77, 82, 88, 89
	F. or T. 3-3, 34, 45 to 51, 59, 60, 66
	5-3 to 9, 11, 13
	F. or T. 5-1
	6-6, 9, 10, 16, 19, 20, 22, 25, 32 to 40, 41, 47 to 52, 59, 64, 68, 69, 70, 71 to 84
	F. or T. 6-1, 4, 10, 15, 26 to 33, 35 to 41, 52, 55, 57 to 59, 64 to 70, 94, 99
	7-64
	F. or T. 7-94
	8-13, 34, 44 to 46, 48
	F. or T. 8-19, 20, 25 to 27
	9-47, 54, 58 (cont)

Skin (cont)	F. or T. 9-36 F. or T. 11-8 12-4 13-10 to 12, 26, 89, 91, 92 F. or T. 13-9 to 12, 14, 15 15-1, 8, 12, 13 F. or T. 15-1 to 3, 5, 6, 9
Skin burn	See Abrasion F. or T. 3-45 5-6 to 9, 12, 13 F. or T. 5-3, 4, 12 to 14 F. or T. 6-94, 95 F. or T. 13-15
Skin conductance	6-69, 70
Skin (folds)	16-21, 54, 70 F. or T. 16-4, 27
Skin temperature, mean	6-6, 9, 10, 16, 19, 20, 25, 32 to 40, 44 to 52, 64, 65, 71, 73, 89, 95, 107, 112 to 116, 121, 125 F. or T. 6-1, 4, 10, 15, 34 to 41, 52, 55, 57 to 59, 61, 64 to 70, 89, 90, 93, 95, 96, 99, 102, 107, 109 F. or T. 11-8
Skin thickness	F. or T. 6-58, 64
Skull	See also Head F. or T. 3-32 5-7, 8 7-64, 81, 191, 197, 213 F. or T. 7-35, 57, 86, 90, 94 8-22, 34 9-17
Sky	2-92 to 95, 97 to 101, 108 to 110 F. or T. 2-6, 71 16-85, 86
Slab	3-32 F. or T. 3-23
Sled-pulling	10-17 F. or T. 10-7
Sled, rocket	7-195 to 205 F. or T. 7-79 to 83, 85, 87, 88
Sleep	7-82, 132 F. or T. 7-63 9-48 F. or T. 9-36 10-40, 66, 75 F. or T. 11-8 (cont)

Sleep (cont)	14-40 16-26, 36, 74, 76, 80 to 96 F. or T. 16-28 to 30
Sleep deprivation.	16-94 to 96
Sleep, depth of	16-92 to 94
Sleepiness	8-46 F. or T. 15-9
Sleeping bag.	6-73, 81
Slit lamp	2-116
Slope	10-7, 15, 23 F. or T. 10-7 to 10, 13, 27, 30
Slough, skin.	3-57
Slow phase, nystagmus	7-67 F. or T. 7-50, 51
Smell	13-91 F. or T. 13-24, 25
Smog	13-86 F. or T. 13-22
Smoke	13-86 to 91 F. or T. 13-22
Snacks	14-14, 18 F. or T. 14-9, 10
SNAP, radiation	3-45
Snellen letters	See Alphanumeric symbols
Snow	F. or T. 2-6, 10 F. or T. 6-102 9-10
Snow blindness	2-116
Snow, locomotion	10-7 F. or T. 10-7 to 9
Snowshoeing.	F. or T. 10-7
Soap	13-26
Sociological factor	8-58 16-69 to 79
Socks	6-121 F. or T. 6-102, 106 F. or T. 16-9
Sodium (ions)	See also Electrolytes and salt F. or T. 3-6 7-116, 126 10-50 14-2, 29, 38 F. or T. 14-6, 11, 13, 19 F. or T. 15-8
Sodium excretion.	7-116, 126
Sodium peroxides, superoxides ozonides	10-42 to 45 F. or T. 10-33
Soft tissue	7-191, 213 F. or T. 7-74, 89

Soil	2-69
Soil, lunar	See also Dust 16-54 to 64
Solar	See Sun
Solar cycle (flare)	3-3, 42, 44, 45 F. or T. 3-33
Solar flare	3-1, 9, 38 to 42, 44, 45, 63, 66, 82, F. or T. 3-28, 32 4-1 F. or T. 4-1
Solar penetration	F. or T. 6-58
Solar wind	3-3 4-1
Soldier	See Army and Military
Sole	2-112
Solid	6-8 14-2, 24 F. or T. 14-1, 13, 14 15-3, 4 F. or T. 15-12, 13
Solid angle	2-52, 53, 57, 69, 70 F. or T. 2-2, 3, 46
Solid Chemical systems, oxygen	10-42 to 45 F. or T. 10-33
Solid, water	15-16 to 26 F. or T. 15-14 to 17
Solubility (coefficient).	F. or T. 11-2 to 4 12-2, 32 13-11, 85
Solute concentration	12-30
Solvents	13-26 to 71
Somatotype	16-21
Sone	9-12, 14 to 17 F. or T. 9-1, 9, 10
Sonic boom	9-56 F. or T. 9-37
Sonic orifice flow.	12-13, 14 F. or T. 12-9, 10
Soreness	8-41 to 45
Sound	See Acoustic (auditory) effects 1-10 7-95 F. or T. 7-74 8-1 9-1 to 82 F. or T. 9-1 to 52
Sound pressure level (SPL)	See Intensity
Sound velocity	11-3 F. or T. 11-1

Source, contaminants	13-17 to 93
South Atlantic anomaly	3-2, 45
Soviet	1-7, 8, 10, 11, 15
	2-69, 70
	3-3, 45, 80, 83
	7-16, 96, 115, 127 to 133,
	165
	F. or T. 7-63
	8-58
	9-78
	F. or T. 10-5
	11-8
	13-79
	F. or T. 13-16
	15-9
	16-47, 71, 84 to 86
	F. or T. 16-24
Space	2-8, 20, 72 to 110
	F. or T. 2-6, 7
	6-9
	12-31
Space cabin	6-18 to 52
	F. or T. 6-80
	8-1, 3, 92
	9-1, 5 to 11, 53 to 55, 81,
	82
	F. or T. 9-3 to 5, 36
	10-57 to 60
	F. or T. 10-5
	11-1, 8, 19 to 38
	F. or T. 11-6 to 10, 15, 16
	12-4, 5, 11 to 18.
	F. or T. 12-9, 12 to 19
	13-1 to 9, 15 to 17, 79, 85 to
	93
	F. or T. 13-15 to 18, 25
	14-18
	15-5, 12, 13
Space chamber	12-10
	F. or T. 16-23
Space flight (operation)	2-69 to 72, 120
	6-40, 95
	F. or T. 6-80
	7-21, 35, 53, 54, 82, 93,
	110, 115, 118, 119, 126,
	133 to 176
	F. or T. 7-63, 66, 67
	8-1, 3, 16, 17, 56, 67, 75,
	77, 78, 89, 92 to 94
	9-1, 3, 5, 6 to 11, 51, 53
	to 56. 76 to 82 (cont)

Space flight (operation) (cont) F. or T. 9-3 to 5, 36, 51, 52
10-25, 26, 53, 65
12-14, 15, 33, 34
13-1, 3, 6, 11, 12, 15 to 17,
56, 79, 85 to 93
F. or T. 13-15 to 18, 23
14-1 to 8, 34 to 42
F. or T. 14-2 to 6
15-4, 9, 12, 13
F. or T. 15-11
16-1, 26 to 36, 38, 48 to 96
F. or T. 16-18 to 23, 25, 26

Space station 16-37, 43, 71 to 77
F. or T. 16-26

Space suit See also Ventilated suits and
Liquid cooled suits and
Pressure suits and Hard suits
1-15
3-7, 44, 62, 87
F. or T. 3-27, 28
6-32, 40, 52 to 70
F. or T. 6-47 to 54
7-38, 133 to 176, 182 to 190,
221
F. or T. 7-18, 66, 73
8-1, 92
9-7 to 9, 81, 82
F. or T. 9-3, 52
10-25, 30 to 46, 65
F. or T. 10-20 to 31
11-1, 20
12-7, 10, 11 to 31
F. or T. 12-12 to 19
13-92, 93
14-14, 24, 29
15-4, 5, 7, 12
16-26, 36 to 38, 48 to 65, 68
F. or T. 16-9, 11, 18 to 24

Space to earth visibility 2-69 to 72, 96
F. or T. 2-58

Spacecraft See also specific program
2-12, 13, 18, 20, 57 68 to
110
F. or T. 2-12, 58
3-30, 33, 56, 81, 83, 87
F. or T. 3-27
4-1, 2
7-8, 53, 56, 133 to 176
F. or T. 7-12, 63 to 67
16-1, 26, 36, 38, 43
F. or T. 16-18 to 22, 25,
26, 48 to 96

SPAMAG	15-5
Sparks	15-13
Spasm	F. or T. 6-90
	7-19
	F. or T. 7-88
Spatial sense	See Orientation
Spatio-temporal environment	16-1 to 96
	F. or T. 16-1 to 30
Speaker	See Talker factor
Species (difference)	See also specific animal
	3-47
	13-12, 14 to 16
Specific gravity	F. or T. 6-58
	F. or T. 13-3
	16-21
Specific heat	See also Heat capacity
	12-25
	F. or T. 12-18
Specific heat ratio	11-3
	F. or T. 11-1
Specific resistance	1-2
	F. or T. 1-2
Specific volume	F. or T.
Spectral sensitivity	See also Specific radiation
	wave
	F. or T. 2-2
Spectrometer	11-39
Spectrum frequency	See Frequency and intensity
Speech	8-67, 79
	F. or T. 8-20, 21, 31, 39
	9-1, 3, 21 to 39, 53 to 55,
	61 to 82
	F. or T. 9-3, 16 to 31, 36,
	51
	11-8
	F. or T. 11-8, 16
	F. or T. 15-9
Speech intelligibility tests	See also Intelligibility
	9-24, 29, 30, 53 to 55
	F. or T. 9-18 to 31
Speech interference level (SIL)	9-30, 31, 60
	F. or T. 9-26
Speed	See also Velocity
	9-50
	F. or T. 14-21
Speed of vision	F. or T. 2-26
Sperm and spermatogenesis	3-62
	F. or T. 3-52
Spermatogonia	3-62, 78
Sphere	3-33
	F. or T. 3-25, 42

Spherical aberrations.	2-24
Spillage	14-14, 15
Spin, aircraft	7-56, 91 to 96
Spin, axis precession	7-110
Spin rate	See Angular velocity
Spinal cord	5-8, 12, 13
Spine	See also Vertebrae
	3-56, 76
	F. or T. 3-32
	7-4, 191, 197, 201 to 205,
	217
	F. or T. 7-1, 10, 81, 86
	8-11, 19, 20
	F. or T. 8-3
	12-41
	F. or T. 16-5, 6
Spinning sensation	See Vertigo and dizziness
Spleen	F. or T. 1-2
	3-42
	F. or T. 3-32
	7-213, 215
	F. or T. 10-41
Spondylitis	3-76
Sprain	F. or T. 7-87, 91
Spring system	7-191 to 195
	F. or T. 7-38
	8-5, 13, 16, 22, 24, 25, 77,
	91 to 94
	F. or T. 8-3 to 5, 15, 32
Sprint	See also Running
	F. or T. 7-151
Sputnik	F. or T. 7-63
Squamous cell carcinoma	3-71
Squares	2-19
Squatting	F. or T. 7-66, 84
	F. or T. 16-16, 22
Stability, food	14-14, 15
	F. or T. 14-7
Stages of sleep	16-92 to 94
Staging	7-53
Stairs	7-183
	10-15
	F. or T. 10-14
Stall	7-95
Standard, water	15-1 to 26
	F. or T. 15-1 to 17
Standing	7-192, 205
	F. or T. 7-69, 75, 84, 92 to
	94
	16-49
	F. or T. 16-2 to 4, 6, 8,
	19 to 22

Standing position	8-3, 5, 11, 17, 20, 21, 36, 46, 48, 56, 91 F. or T. 8-6 to 8, 10, 13 14, 20, 23, 31, 35
Stapes and stapedial reflex	9-40 F. or T. 9-2
Staphylococci	13-92 15-20
Star	2-8, 37, 42, 57, 58, 82, 93 95, 96 to 101 F. or T. 2-6, 8, 9, 15, 73, 74
Star formation	3-2, 88
Star tracking devices	2-82
Starch	F. or T. 15-7
Starvation	See also Food 3-71 10-25 14-34 to 42 F. or T. 14-18, 21
Steadiness, hand.	16-94 F. or T. 16-23
Steadiness test	8-91
Steel fabric	12-12
Stefan-Boltzman constant.	6-20 F. or T. 6-1
Stepping (length and rate).	See also Stride 7-179 to 183 F. or T. 7-70
Stereoscopic acuity	F. or T. 2-15
Stereoscopic function.	16-94
Sterilization, spacecraft	13-92, 93
Sterilization, water	15-18, 20 to 26 F. or T. 15-14, 17
Sternum	F. or T. 3-32 8-41 F. or T. 8-21, 25
Steroids	8-51
Sterol esters	F. or T. 13-3, 7, 8, 12
Stick force	7-48 F. or T. 7-28
Stiffness	See also Springs 8-91, 94 F. or T. 8-16
Stilbs	F. or T. 2-4
Stiles-Crawford effect	2-23, 24 F. or T. 2-2
Stimulants, nervous system	F. or T. 13-15, 16, 18
Stockings, anti G	F. or T., 7-18
Stomach	9-7, 9 F. or T. 9-4 15-1 F. or T. 15-2

Stomach temperature	F. or T. 6-107
Stone, urinary (calculus)	10-73
	15-5
Stopping power	3-10, 18, 33, 38
	F. or T. 3-8, 9, 11, 12,
	15
Storage, carbon dioxide.	10-65, 66
Storage, chemical	13-9, 11, 17
	F. or T. 13-5
Storage, food	14-2, 8, 14, 15, 34
	F. or T. 14-10
Storage, gas.	12-8, 9, 14, 15
Storage, heat	6-10, 48, 60, 62, 71, 90, 91,
	95 to 98
	F. or T. 6-2, 3, 77 to 79
Storage penalties, gas	10-42 to 45
	F. or T. 10-33
	11-20 to 32
	F. or T. 11-10 to 14, 16
	F. or T. 15-11 to 14
Storage, water	7-192
Stored energy	16-26, 36, 76
Stowage	3-10
Stragglings factors	7-119
Strain gage	6-103
Strain, thermal	F. or T. 6-90
	7-5
Straining	7-133 to 176
Straps	F. or T. 7-66
	See also Force
Strength, human	14-36 to 42
	F. or T. 14-21
	16-3, 36 to 64
	F. or T. 16-13 to 22
	14-32
Strength, plastic	F. or T. 14-15 to 17
Strength, tissue	7-191, 217
	F. or T. 7-74
Streptococci	13-92
Stress, cold.	6-9, 15, 16, 73, 107 to 127
	F. or T. 6-72, 79, 80 to
	113
Stress, combined	See Combined stress
Stress, heat.	6-9, 15, 16, 57, 71 to 113
	F. or T. 6-58 to 98
Stress, physiological.	See also Combined stress
	2-13, 14
	7-126
	F. or T. 7-65, 78
	8-48 to 51
	9-49 (cont)

Stress, physiological (cont)	F. or T. 11-8 13-3, 15 to 17 F. or T. 13-1 15-6, 9 to 13 16-69 to 96
Stretch	F. or T. 16-8, 22
Stretch receptor	7-57
Stride	7-179 to 183 F. or T. 7-70 10-15, 32, 36 to 40 F. or T. 10-12 F. or T. 16-22
Stroboscopic system	8-8 16-55, 62
Stroke volume	7-16 F. or T. 7-63
Stupor	5-9 F. or T. 10-47
Subcritical storage, cryogenic	11-25 to 31 F. or T. 11-12 to 14
Subgravity	7-1, 166, 177 to 188 F. or T. 7-70 to 73 10-1, 15, 25 to 46 F. or T. 10-20 to 30 F. or T. 14-8 16-43 to 64 F. or T. 16-18 to 22
Subjective sensation	8-16, 17, 36 to 48, 56 to 59 F. or T. 8-20 to 37
Submarine (nuclear)	2-73 10-71 to 76 13-1 to 4, 5, 15 to 17, 86, 91, 92 F. or T. 13-16 16-87 F. or T. 16-25, 26
Sucrose (sugar)	F. or T. 15-7
Sugar	F. or T. 13-3, 7 to 9, 13
Sugar coating	F. or T. 14-10
Suit	See also Space suit 1-15
Suit joint	16-54 to 64
Sulfur and sulfide	F. or T. 3-6 F. or T. 13-15 to 18
Sulfur dioxide	6-25 F. or T. 13-15 to 19
Summer	6-15 F. or T. 6-7 F. or T. 16-9
Sun	See also specific solar events 2-8, 10 to 13, 56 to 58, 92, 97, 98, 109 to 120 (cont)

Sun (cont)	F. or T. 2-6, 7, 10, 71 3-1 to 3, 42 6-9, 12, 25 F. or T. 6-1, 2, 4, 58, 67 78, 91 16-86, 91
Sunburn.	See Erythema, skin
Suntan	See Tanning
Supercritical storage, cryogenic	11-25 to 31 F. or T. 11-12 to 14
Superinsulation	See also Radiant insulation 12-12
Superoxides	10-42 to 45 F. or T. 10-33 13-91
Supination	F. or T. 16-12, 18, 19, 22
Supine (position)	7-8, 77, 83 F. or T. 7-69 8-5, 11, 13 to 17, 19, 41 to 45 F. or T. 8-9, 10, 12, 13, 24, 25, 31, 35
Support	See Seat or restraint
Support stick	7-187
Suppressed carrier techniques	9-39
Surface	See also Area and skin and Terrain and Area, body surface F. or T. 5-2 6-21, 22, 73, 91, 107, 112 F. or T. 6-1, 4, 16, 22, 58, 64, 102
Surface area	See Area, body surface
Surface, moon	See also Moon and Dust and Soil 2-8, 11, 12, 108 to 110, 120 7-177 to 190 16-37, 38 to 64, 86 F. or T. 16-18 to 23
Surface, planet	2-8, 11, 12 7-177 to 190 8-7, 32
Surface wave	See Discharge current
Surge current	1-9, 10
Survey	F. or T. 2-11
Surveyor	See also Death
Survival	6-107, 121 F. or T. 6-73, 77, 101 to 105 F. or T. 7-77, 83 14-34 to 42

Survival ration	14-3, 34
Survival time	See also Death 3-48, 53, 59, 74 F. or T. 3-36, 37 15-6 to 13 F. or T. 15-9, 10
Sustained linear acceleration	See Acceleration, linear (sustained)
Sweat	See also Evaporation 5-4 6-1, 10, 16, 18, 19, 32 to 40, 58, 59, 68, 81, 89, 90, 95 F. or T. 6-26 to 34, 45, 47, 49, 52, 55, 58, 66 to 71, 74, 76, 78, 90, 92, 93, 102 7-62, 82, 116, 117, 197 F. or T. 7-55 10-19, 30, 66, 69 F. or T. 10-47 13-12, 17 F. or T. 13-7, 14 15-4, 5 to 8, 12, 13 F. or T. 15-2, 3, 5, 6, 13
Sweat gland	2-111 F. or T. 2-78
Sweat rate	6-32 to 40, 44 to 49, 81, 89 F. or T. 6-1, 26 to 34, 52, 93
Swelling	See Edema
Swimming	F. or T. 10-7
Switch (flipping)	7-48, 63, 67, 187 F. or T. 7-27 8-67, 78 F. or T. 10-21, 22 16-2, 3 F. or T. 16-19
Syllable	See also Nonsense syllable 9-35
Symbol manipulation	See also Alpha-numeric 6-64 7-49
Sympathetic N.S. response	See also Autonomic N.S. 7-46, 117, 199 F. or T. 7-63, 78 9-48, 49 10-66, 74
Symptom	See also Subjective sensation 3-8, 45 to 63 F. or T. 3-36, 37, 39 F. or T. 7-19, 63, 65 (cont)

Symptom (cont) F. or T. 8-31
 10-65 to 76
 F. or T. 10-47
 12-2 to 10, 16 to 34
 F. or T. 12-2 to 7
 13-80
 F. or T. 13-15, 18
 Syncope (fainting) See also specific symptom
 7-119, 125
 10-69, 70
 F. or T. 10-40
 F. or T. 11-8
 12-4
 Synergism See also Combined stress
 3-80, 81
 F. or T. 3-65
 9-51
 13-13, 15 to 17

T

T-wave. F. or T. 7-10
 Table, shake 8-11, 13, 19, 20, 23, 36
 F. or T. 8-6 to 11, 14, 21,
 29
 Tachycardia. 7-16, 62
 F. or T. 7-32
 Tactile sense 6-121
 7-132
 F. or T. 7-36, 65
 F. or T. 8-39,
 9-47
 F. or T. 9-32
 16-63
 Takeoff. See also Launch and liftoff
 8-51, 56, 89
 Talbot's law. 2-37, 38
 Talker factor See also Voice
 9-21 to 24, 31, 35, 53, 61
 F. or T. 9-16, 17, 23, 25,
 28
 Tankage penalties, gaseous 11-20 to 32
 F. or T. 11-10 to 14, 16
 Tanning. 2-114, 115
 Tapping test 7-49
 8-78
 F. or T. 14-21
 Target (recognition and detection) 2-91
 10-51
 16-94

Target size	2-15, 36, 46, 57, 61, 87, 94, 95, 101 to 103 F. or T. 2-15 to 17, 33, 46 to 49, 66
Target, test	8-67 to 78 F. or T. 8-44 to 47
Target, visual	7-91 to 94 F. or T. 7-23, 30, 52, 56, 63, 65
Task	See also Performance and specific task F. or T. 8-48 to 51 9-49 to 55, 81, 82
Task analysis	7-133 to 176, 187 to 190 F. or T. 7-65, 66, 70 10-30 16-1, 43, 47 to 64, 70, 71, 78, 79, 82 to 96 F. or T. 16-18 to 22
Task overloads	8-85
Taste	F. or T. 4-2 7-12 F. or T. 15-15
Tear (eye)	2-115, 143 7-19, 29 13-10, 26 F. or T. 13-13
Teeth	4-3 15-13
Telangectasis	3-71
Telegraph tests	F. or T. 6-81, 84, 88
Telescope	2-68, 82, 99 F. or T. 2-11
Television	See Cathode ray tube display
Temperature	See also Temperature of specific structure and Heat stress 1-2, 9 to 12 F. or T. 2-2 9-10 10-1, 19, 40, 43, 58, 66, 67 F. or T. 10-1, 4, 13, 18, 33 11-1, 3, 25 to 38 F. or T. 11-4, 6 to 8, 15, 16 12-2, 11, 12, 30 13-2, 3, 5, 6, 15 to 17, 26 F. or T. 13-22 14-14, 15, 29, 40, 42 F. or T. 14-7
Temperature, body	8-34, 35, 48 15-4 (cont)

Temperature, body (cont) F. or T. 15-9
 16-80, 81, 89, 92
 F. or T. 16-27
 Temperature, critical. F. or T. 11-1
 Temperature regulation See also specific factor
 F. or T. 6-73
 15-1
 F. or T. 15-9
 Temporal factor See also Duration
 16-1, 69 to 96
 F. or T. 16-25 to 30
 Tendon 8-32, 34
 Tensor tympanic muscle 9-40
 Tent 2-31
 Terminal absorption See Thindown and Bragg peak
 Terrain 10-15, 17
 F. or T. 10-5, 7 to 9, 13
 Territoriality 16-70, 76 to 78
 Test facilities 9-9, 52, 55, 57, 76
 F. or T. 9-5
 Test or target speed F. or T. 6-86
 Testing, water purity 15-16 to 26
 F. or T. 15-14 to 17
 Testis See also Germinal epithelium
 1-8, 9
 F. or T. 1-7
 8-44 to 46
 F. or T. 8-20, 25
 Tetany 5-11, 13
 F. or T. 5-4, 5
 F. or T. 10-49
 Tether Lines. 7-127, 133 to 151, 158 to 166
 F. or T. 7-65 to 67
 Tetracycline 13-93
 Theodolite 2-108
 Therapy See Treatment
 Thermal. See Heat and specific thermal
 Thermal circulation index. 6-112
 Thermal conductivity 10-58, 59, 60
 F. or T. 10-43
 11-1, 31, 32, 39
 F. or T. 11-1, 5, 15, 16
 Thermal environment 6-1 to 127
 F. or T. 6-1 to 113
 Thermal factor (effect) See also Heat and Tempera-
 ture
 3-80
 F. or T. 3-65
 8-34, 35, 51
 13-79, 80
 16-26, 48, 54 to 65, 68, 80,
 96
 F. or T. 16-22, 23, 27

Thermal inertia	See also Latency 6-71 F. or T. 6-58, 64, 65
Thermal-meteoroid garment	See T.M.G.
Thermal neutrality zone	F. or T. 6-9
Thermal process	9-10
Thermal protection	12-12
Thermal resistance	See Clothing insulation
Thermodynamic properties	11-1, 21 to 38 F. or T. 11-1, 15, 16
Thermoelectric distillation	15-25 F. or T. 15-17
Theta rhythms	16-93
Thiamine	14-2 F. or T. 14-1, 6, 11, 13
Thickening, skin	2-114
Thigh	6-73 F. or T. 6-26 to 29, 54, 57, 94 7-22, 39, 203 F. or T. 8-20 F. or T. 13-12 16-26 F. or T. 16-2 to 4, 10, 11, 23
Thin film gas sensor	11-39
Thindown	3-1
Thiocyanate space	14-46
Thirst	F. or T. 6-68 7-130 15-11, 12 F. or T. 15-9
Thorax	5-7 F. or T. 5-5 6-73 F. or T. 6-26 to 29, 54, 57 8-11, 16, 17, 19, 21, 34, 44, 45, 79 F. or T. 8-12, 13, 21 to 23, 25 12-20 to 30
Threshold	See also Sensation 8-46, 47, 70 to 76, 85 to 94 F. or T. 8-26, 27, 35, 40 to 43, 51 16-71 to 77 F. or T. 16-25, 26
Threshold, damage	See Damage, threshold
Threshold dose	See Dose
Threshold, hearing	9-3, 11, 12, 17, 18, 20, 24 to 33, 41, 53 to 55 (cont)

Threshold, hearing (cont)	F. or T. 9-6 to 9, 11 to 15, 18, 36
Threshold limit values (TLV)	13-1, 2, 4, 13, 15 to 17, 56, 79, 82 F. or T. 13-15, 16, 19, 20, 21
Threshold, sensory	7-43, 82 to 87, 114, 125, 149 F. or T. 7-39, 40, 57, 65, 94
Threshold stellar magnitude	2-8 F. or T. 2-10
Threshold, visual	10-49 F. or T. 10-36 to 38
Throat	F. or T. 8-21 9-53 13-86 F. or T. 13-15
Thrombi (clot)	7-64
Thrombosis	12-30
Thrust	9-7, 10 F. or T. 9-3 to 5
Thumb	F. or T. 13-10 F. or T. 16-3, 4, 19, 23
Thyroid gland	1-8, 11 3-76, 77, 89
Tickle	9-47, 53, 54 F. or T. 9-32, 36
Tidal volume	F. or T. 7-13 10-63 F. or T. 13-23
Tilt	See also Back angle and Body lean 7-67 to 74, 83, 93 to 101, 110, 116 to 125 F. or T. 7-47 to 49, 52, 53, 56, 58 to 62
Tilt table test	7-116 to 125 F. or T. 7-63
Time	See Duration
Time consciousness	16-79, 94, 95
Time constant	F. or T. 7-30, 39 12-9, 15 to 30 F. or T. 12-8, 12 to 19
Time lag constant	F. or T. 7-30, 39
Time of useful consciousness	12-16, 31, 32 F. or T. 12-11
Timing	7-54
Tissue	3-4, 18 5-1 to 3, 7 F. or T. 6-65 (cont)

Tissue (cont)	7-4, 59, 197, 212 F. or T. 7-78, 89 8-7, 8, 22 to 36 F. or T. 8-16 to 19, 31 9-56 to 58 12-7 to 10, 30, 40 13-9, 11, 14 15-4
Tissue culture	4-3 15-21
Tissue equivalent dosimetry	3-10, 33, 86, 87 F. or T. 3-14, 25, 55
Tissue half-time	12-7 to 9 F. or T. 12-5, 8
Tissue thickness (shielding)	3-42 F. or T. 3-30, 31, 34
Titov	7-131 F. or T. 7-63
T.M.G.	16-48, 54, 55, 62, 63 F. or T. 16-22, 23
Tocopherol	10-55 13-16 14-2 F. or T. 14-6
Toe	6-121 F. or T. 6-102, 106 F. or T. 13-10
Toggle switch	7-63, 189 F. or T. 7-27
Toilet facilities	13-26 16-76
Tolerance (limit)	See also Physiological response 1-11, 12 F. or T. 1-7 7-5, 6, 8 to 54, 82 to 96, 102 to 110, 187, 190, 195 to 221 F. or T. 7-2 to 19, 52 to 61, 63, 77 to 94 8-36 to 46, 51 to 59, 85 to 94 F. or T. 8-20 to 37, 51 9-53 to 55, 58 to 82 F. or T. 9-4, 36 F. or T. 12-17 16-71 to 77 F. or T. 16-25, 26
Tolerance mechanism	13-14, 15
Tolerance time	See also Performance time 6-9, 16, 73, 81, 90, 91, 95 to 101, 113 to 116, 121 (cont)

Tolerance time (cont).	F. or T. 6-1, 35 to 37, 72, 74 to 81, 93 to 95, 97, 101 to 105
Tone, pure	9-12 to 18, 42, 59, 62, 75, 77 to 80
Tool	F. or T. 9-6 to 9, 32, 41 See also Hand tool F. or T. 5-2 8-21, 22, 56, 91 F. or T. 8-15, 33, 35 16-49 to 64 F. or T. 16-19
Torque (task)	See also force 10-28
Torque tool	7-127, 189 F. or T. 7-65, 70
Torsion pendulum	7-67, 75, 77 F. or T. 7-36, 42
Torso	See Body
Total body effect.	See also Whole body exposure 1-8 to 12 F. or T. 1-7
Touch	See Tactile sense
Tower simulator	F. or T. 7-63
Toxic material	See also Contaminant 2-68, 69
Toxicity.	3-82 F. or T. 11-8, 16 13-1 to 4, 6, 9 to 17, 26 to 93 F. or T. 13-15 to 21
Tower, launch	8-91
Trace contaminant	See Contaminant, trace
Trace minerals	14-3 F. or T. 14-6
Trachea.	8-17 F. or T. 8-3 10-46, 49, 60 F. or T. 10-34, 46, 48 F. or T. 12-29
Track, ionization	See also Core, ionization 3-26, 30, 44, 88
Tracking (task)	2-91 6-48 F. or T. 6-112 7-48 to 56, 63, 76 to 82, 83, 85, 132 F. or T. 7-3, 28 to 31, 49 8-67, 79 to 94 F. or T. 8-48 to 51
Tracking, visual.	7-76 to 82 F. or T. 7-49

Traction	7-177 to 190 10-27, 28 F. or T. 10-23
Tractor	8-35, 51, 56 F. or T. 8-33
Tradeoff	14-3 to 8 F. or T. 14-2 to 6
Train	8-91 F. or T. 8-36
Train noise	F. or T. 9-10, 11
Train sickness	See also Motion sickness 7-82
Training	See also Acclimatization and Habituation and adaptation 6-98 F. or T. 6-60, 80, 85 7-5, 49, 93 to 96, 127 to 133 F. or T. 7-65, 66 10-7, 19, 22, 24 F. or T. 10-2, 7, 11, 13, 17 15-12 16-43, 71, 79
Training, speech	9-21 to 24, 29, 30, 31, 35, 61, 81, 82 F. or T. 9-25, 28
Trampoline	7-125
Tranquilizer	3-51 7-90
Transducer	7-87 9-58
Transfer function	7-75 to 82 F. or T. 7-44, 45, 47 to 51 8-23 to 31, 60, 62 to 67 F. or T. 8-17, 18, 38
Transfer of training	2-27, 82, 98, 99
Transfer volume	16-74
Transformation, biochemical	13-11, 12
Translation, body	See also Extravehicular activity 7-213 to 221 F. or T. 7-65, 91 to 94 16-16
Translation, lunar	2-105
Translatory movement	F. or T. 10-20
Transmission factor	6-11 F. or T. 6-58
Transmission, vibration	8-3, 6 to 34, 40 to 48, 91 to 94 F. or T. 8-3 to 19, 21, 47
Transmittance	2-1, 60, 65, 66, 80, 81, 94, 110 F. or T. 2-2, 77, 81, 82

Transmitter	9-36 to 39
Transparency	14-15, 32
Transpiration	F. or T. 15-2
Transport code	3-31 to 33
Transverse A-P-G	See also +G ^x F. or T. 7-1
Transverse acceleration	See $\pm G$
Transverse P-A-G	See also -G ^x F. or T. 7-1
Trapezoidal pulse	7-215
Trapped radiation	F. or T. 7-76, 78 to 81, 90 4-1
Trauma	See also specific injury 2-120 3-58, 61, 62, 71 F. or T. 7-5, 7, 9 to 11, 16, 17
Treadmill	10-7, 17, 19, 23 F. or T. 10-13, 22, 26 14-34 to 42
Treadmill speed	See Walking speed
Treatment	See also specific drug 3-82 7-102, 201 10-53, 70, 71, 75 9-57 12-10, 29, 30, 33, 34 13-89
Tremor	7-83 F. or T. 7-78
Treshkova	7-131 F. or T. 7-63
Triangular pulse	7-213, 215 F. or T. 7-76, 90
Trichloroethylene	13-81
Trimwheel	F. or T. 7-27
Tristimulus values and function	2-33 F. or T. 2-2
Troland	2-60 F. or T. 2-2, 52, 55
Tropics	F. or T. 6-60, 67
Trouser	16-54 to 64 F. or T. 16-9, 23
Trucks	8-35, 51, 56 F. or T. 8-33, 36
Trunk (torso)	3-7, 51, 61 6-33, 57, 70 F. or T. 6-22, 45, 53 7-6, 19, 35, 76 to 82, 94 16-3, 16, 49, 55, 65 F. or T. 16-2 to 6, 10, 11, 19, 23

Tubed foods	14-24, 29 F. or T. 14-13, 14
Tubing	See also Liquid cooled suit 6-66 to 70 F. or T. 6-54
Tumbling	See R _y and R _x
Tumor	See Neoplastic disease
Tunnel vision	7-17, 19
Turbidity	F. or T. 15-14, 15, 17
Turbojet	See Jet noise
Turbulence	See also Buffeting 9-7, 9, 11
Turn	7-93 to 96, 98 to 110 F. or T. 7-58 to 61
Turn table	F. or T. 7-7
Turtles	F. or T. 7-63
Two-edge limen	6-121
Two-point test	6-121 F. or T. 6-109
Tympanic membrane	See Eardrum
UDMH	F. or T. 13-20
Ulcer, peptic	10-74
Ulceration, skin	2-68, 110-120 3-57, 59 F. or T. 3-45 13-10 F. or T. 13-15
Ultrafiltration	15-25 F. or T. 15-17
Ultrasound	8-33, 34, 35 F. or T. 8-19 9-1, 56 to 58 12-9
Ultrastructure	7-191
Ultraviolet (light).	See also specific effects 2-66, 79 F. or T. 2-77 to 83

U

Umbilical, EVA	7-133 to 151 F. or T. 7-66, 67 12-27, 28 F. or T. 12-19 16-36 F. or T. 16-23
Unbalanced controller.	F. or T. 7-28

Unconsciousness	See also Syncope and Consciousness 7-8, 12, 46, 49, 119, 197 F. or T. 7-6, 8, 19, 32 12-11 to 16 F. or T. 12-10, 11
Underwater blast or explosion	7-215 F. or T. 7-91 12-40
Underwater simulation (task)	7-133 to 176 F. or T. 7-68, 69 10-30 F. or T. 10-7, 20
Underwater visibility	2-28, 36
Underwear	6-49, 56 F. or T. 6-94, 97, 101 F. or T. 16-9
Unit	F. or T. 6-1 9-2 13-4 to 9
United Kingdom	1-11 3-76
United Nations	F. or T. 10-4
Universal gas constant	11-3
Unsaturation, blood	7-21, 29, 54 F. or T. 7-14, 15
Uphill walking	10-7, 15, 39 F. or T. 10-7 to 9, 11, 13
Upright.	See Vertical
Upside-down illusion	See Inversion illusion
Uranium	3-18 F. or T. 3-15
Urinary nitrogen	F. or T. 15-7, 8
Urine (urination)	6-1 F. or T. 6-89 7-116 to 127 F. or T. 7-63 8-36 F. or T. 8-20, 21 10-72 to 76 13-12, 17 F. or T. 13-3, 5, 14, 15 14-3, 36, 38 F. or T. 14-14, 19 15-1, 3, 4, 6 to 9, 11, 16 to 36 F. or T. 15-1, 2, 5, 6, 7, 9, 13, 17 16-80, 81
USAF	See also Air Force 6-105 16-3, 21 F. or T. 16-3, 5 to 12, 17

USDA 14-18
 F. or T. 14-19
 USPHS 15-16 to 26
 F. or T. 15-14 to 17
 Utilization, food. 14-2
 Utricle 7-64, 67 to 80
 F. or T. 7-35, 43 to 51

V

V-test 6-121
 F. or T. 6-109
 Vacuum See also Chambers, vacuum
 12-18, 31, 32
 14-14
 F. or T. 14-10
 Vacuum distillation 15-19
 Vagal response 7-17, 117
 F. or T. 7-78
 12-31, 34
 Valsalva response. 8-36
 F. or T. 8-20 to 22
 Van Allen Belt 3-1 to 3, 18, 42, 45, 66
 F. or T. 3-32, 34
 van't Hoff's Law 6-112
 Vapor See also specific contaminant
 13-5, 6, 91
 F. or T. 13-15, 16
 Vapor compression 15-25
 F. or T. 15-17
 Vapor conductance and resistance. See Clothing
 Vapor lock 12-30, 32
 Vapor pressure. 13-5, 91
 Vapor pressure, water See also Humidity
 6-33, 36 to 39
 F. or T. 6-1, 11 to 13, 30 to
 32, 66 to 68, 74
 12-18
 15-8
 Vaporization See also Evaporation
 6-1
 Variable filter lenses 2-66
 Vascular change 2-68
 Vasoconstriction 7-62, 116 to 125
 9-48
 F. or T. 9-35
 Vasodepressor reaction 7-117
 Vasodilation and constriction. See Vasomotor control
 Vasomotor control or regulation 6-19, 68 to 70, 125
 F. or T. 6-3, 56, 97, 107(cont)

Vasomotor control or regulation (cont) 7-59 to 62, 110 to 125
F. or T. 7-32, 33, 63
8-35, 48, 49, 51
F. or T. 8-28
10-66, 67, 73, 74

Vector See also specific vector and
axis
7-6, 8, 48, 96 to 101, 105,
187 to 221
F. or T. 7-1, 2, 5, 7, 9 to
11, 16, 17, 37, 58 to 60,
75 to 94

Vehicle 10-6
F. or T. 10-7

Vein 7-17, 56, 57, 116 to 125
12-30, 32, 35

Velocity See also specific velocity
3-26, 30
6-27, 28, 61 to 70
F. or T. 6-1, 4, 23, 24, 51,
52
7-75, 77, 168, 177 to 190,
203, 212, 215 to 218
F. or T. 7-68 to 73, 77, 81
82, 92, 94
8-2, 8, 32, 33, 41
F. or T. 8-1, 2, 24, 47
10-7, 15, 30, 32
F. or T. 10-2, 7, 10 to 14,
20 to 30

Velocity, gas 6-7, 10, 12, 25 to 31, 39,
42 to 52, 70, 89, 113,
121, 125
F. or T. 6-4, 7, 10, 21,
34 to 41, 74, 76, 78, 86,
92, 95, 98, 99, 102, 106,
108
F. or T. 10-21
11-3, 32
F. or T. 11-15
13-86 to 91
F. or T. 13-25
15-4
F. or T. 15-6

Velocity, linear 8-2, 8, 32, 33, 41
F. or T. 8-1, 2, 24, 47

Velocity of light F. or T. 2-2

Velocity, sound 8-33
9-1, 10

Velocity, target See also Angular rate and
Perception
2-98, 99, 103, 105 to 108

Venous pressure 7-17, 57, 62, 110 to 125
 F. or T. 7-32, 33
 Venous return 7-56, 62, 110, 116, 117
 Venous tone 7-117
 Ventilated suit (clothing) See also Space suit
 6-60, 62, 73
 F. or T. 6-47 to 50, 53, 68
 7-187
 F. or T. 7-70
 16-55, 62
 F. or T. 16-9, 11, 21, 23, 24

 Ventilation noise 9-30
 Ventilation-perfusion ratio 7-29
 Ventilation rate See Respiratory rate and depth

 Ventilation, respiratory 7-29
 F. or T. 7-13
 8-48
 F. or T. 8-28, 29
 10-23, 63, 65, 69, 70, 71, 74
 F. or T. 10-18, 48
 14-35, 38
 F. or T. 14-20

 Ventilation, room See also Volume flow rate
 F. or T. 13-25

 Venting See Leakage
 Venting, cryogenic 11-27 to 31
 Ventricular fibrillation See also Fibrillation, heart
 12-34
 13-55
 F. or T. 13-15

 Venule 2-111
 Venus 4-1
 Vernier acuity F. or T. 2-15
 Vertebrae See also Spine
 5-13
 7-191, 217
 F. or T. 7-2, 86

 Vertical. 7-67, 77, 83, 95, 117, 190
 F. or T. 7-35, 46 to 51, 53, 57

 Vertical vibration See $\pm G$
 Vertigo 7-57, 90, 95, 96, 127 to 133
 F. or T. 7-63
 9-47, 48

 Vestibular illusion 2-42, 95
 Vestibular system (function) 3-81, 83
 F. or T. 3-65
 7-38, 46, 62, 63 to 110, 127 to 133 (cont)

Vision (cont).	36, 55, 56, 63, 87 8-3, 56, 67 to 94 F. or T. 8-39 to 48 10-49 to 53, 69 F. or T. 10-35 to 38, 47 F. or T. 11-8 13-84 F. or T. 13-15 F. or T. 15-9 16-36, 37, 54, 62, 93, 94 F. or T. 16-8, 24
Vision (task).	See also specific task 9-50, 53 to 55, 57 F. or T. 9-36
Visor	2-42, 65, 66, 78 to 81, 108 to 110, 120 F. or T. 2-61 7-133 to 168 12-11 16-48, 54, 65 F. or T. 16-21 to 24
Visual acuity	2-13 to 15, 36, 51, 61 to 65, 69 to 72, 94 F. or T. 2-13, 23, 29, 33, 39, 52, 53, 58, 71 7-19, 41, 106 F. or T. 7-22, 24
Visual angle	2-8, 14 to 19, 31, 33, 57, 61, 68, 69, 70, 87 to 92, 94, 95, 101 to 108 F. or T. 2-2, 14, 15, 18, 19, 21, 24, 45, 48, 49, 58, 71 7-19
Visual axis	F. or T. 2-1, 24
Visual cue	9-29, 81 F. or T. 9-24, 27
Visual detection lobe	2-25
Visual field	2-38, 53, 74, 79 to 82, 105, 106 F. or T. 2-37, 38 7-44, 91, 93 8-70 F. or T. 8-40 F. or T. 10-36, 38 16-54, 65, 68 F. or T. 16-24
Visual illusion	7-90 to 95
Visual magnitude	2-8, 93, 98, 99 F. or T. 2-9, 15
Visual motor task	7-46 F. or T. 7-63, 65

Visual noise	2-38, 90 F. or T. 2-70
Visual performance	2-13
Visual range	2-27, 28, 69, 85 to 95, 101 to 106 F. or T. 2-27, 61 to 63, 71, 72, 75
Visual reaction time	F. or T. 6-112
Visual sensation	4-2
Visual task	8-75 to 78, 83, 85, 88 F. or T. 8-44, 47 to 51
Visual threshold	2-13
Vital capacity	F. or T. 7-13 F. or T. 11-8
Vitamin	F. or T. 13-3, 7, 8, 13 14-2 F. or T. 14-1, 6, 13
Vitamin A	14-2 F. or T. 14-1, 6
Vitamin B ₆	F. or T. 14-13
Vitamin B ₁₂	14-2
Vitamin C ₁₂	14-2 F. or T. 14-1, 6
Vitamin D	2-112 F. or T. 2-79 14-2 F. or T. 14-6
Vitamin E	See also Tocopherol F. or T. 14-6
Vitamin K	14-2 F. or T. 14-6
Vitreous humor	F. or T. 1-3
Vocabulary	9-30 F. or T. 9-25 to 27
Voice	See also Speech F. or T. 7-36 11-3, 8 F. or T. 11-16
Voltage	5-2 to 19 F. or T. 5-3 to 5 9-39
Volume	F. or T. 6-58, 64 F. or T. 8-12 13-6 to 9, 91 F. or T. 13-1, 3 to 14, 25 14-3, 17, 18 F. or T. 14-6 to 8
Volume, body	F. or T. 6-58, 64
Volume, cabin	12-13 to 18 F. or T. 12-9, 10, 12 to 19 13-6 to 9, 91 F. or T. 13-1, 25 (cont)

Volume, cabin (cont)	16-26 to 36, 54, 55, 62, 63, 70 to 79 F. or T. 16-25, 26
Volume compressibility	F. or T. 7-74
Volume factor	3-7, 51, 56, 77
Volume flow rate.	6-33, 40, 62 F. or T. 6-48 to 50 F. or T. 13-25
Volume, lung	12-16 to 31 F. or T. 12-19
Volume penalties.	11-21 to 31 F. or T. 11-11 to 13
Volume receptor, blood	7-116
Volume, suit	12-16 to 30 F. or T. 12-13 to 19 F. or T. 16-23, 25 (cont)
Voluntary dehydration	15-11
Vomiting	3-46, 51, 53, 82 F. or T. 3-36, 41, 42 7-82, 83, 90, 127 F. or T. 7-56, 57, 65 9-47, 76 10-69 F. or T. 13-14, 15 to 21 14-35 15-1, 11 F. or T. 15-2
Voskhod	7-131, 132 F. or T. 7-63 16-43, 85
Vostok	3-45 7-131 F. or T. 7-63 16-84, 85 F. or T. 16-25
Vowel	9-37, 38

W

Waist	F. or T. 16-2 to 4, 11, 23
Wakefulness	16-79 to 90 F. or T. 16-28
Walking	F. or T. 6-61 to 63, 68, 90, 92, 93 7-48, 106, 127, 166 to 190 F. or T. 7-65, 70, 73 10-7 to 17, 65, 75 F. or T. 10-1, 2, 7 to 13 12-31 (cont)

Walking (cont) 14-34 to 42
15-11
F. or T. 15-10
16-49 to 64
F. or T. 16-22

Wall temperature 6-6, 9, 10, 22, 25, 47, 48,
49, 51, 89
F. or T. 6-1, 4, 6, 15, 19,
35 to 37, 69, 77, 97

Warmth 10-67
F. or T. 10-47

Warning light See Signal light

Warning system 9-80 to 82

Wash water 15-13, 16
F. or T. 15-11, 12

Washing 7-167

Waste See also Contaminant
14-9
16-71

Waste disposal 14-15

Waste product 15-1

Waste water 15-13
F. or T. 15-12, 13

Water See also Body water
F. or T. 1-6
2-8, 110, 115
3-18
F. or T. 3-18
5-4, 6, 8
F. or T. 5-2
8-33, 34
F. or T. 8-19
11-32, 33
F. or T. 11-2 to 4, 8, 15
12-2, 18, 31
F. or T. 12-1
13-11, 17, 85, 92
F. or T. 13-7, 8, 10 to 14,
22
14-2 to 8, 15, 16, 29, 32,
34, 36, 38
F. or T. 14-1, 2 to 11, 13
14
15-1 to 26
F. or T. 15-1 to 17

Water balance 15-1 to 5, 7, 8, 9, 11
F. or T. 15-1 to 3

Water content F. or T. 6-58, 64, 65

Water-cooled suit See Liquid-cooled suit

Water immersion 7-38, 110 to 176
F. or T. 7-4, 5, 7 to 11,
16 to 18, 63, 68, 69

Water impact	7-190
Water intake and output	6-33, 40 F. or T. 6-68, 75, 89, 90 7-16, 116, 126 F. or T. 7-63 15-3 to 9, 11, 12 F. or T. 15-1 to 8, 10
Water of hydration	F. or T. 15-2
Water purity	15-16 to 26 F. or T. 15-14 to 17
Water recovery recycling	15-16 to 26 F. or T. 15-17
Water requirement	15-4, 5, 8, 13 to 18 F. or T. 15-5 to 8, 10, 11 to 13
Water temperature	6-62 to 70, 73, 81 F. or T. 6-51, 56, 103 to 105, 107
Water (vapor pressure)	See also Vapor pressure, water 10-46 F. or T. 10-33, 34
Water vehicle	8-1
Watt·sec	See Joule
Watts	F. or T. 2-2, 3, 5
Wave, blast	12-34 to 41 F. or T. 12-20 to 23
Wave height	10-40 F. or T. 10-32
Wave phenomena	See also specific vibration form 7-82, 83, 194 F. or T. 7-78 to 81 86 8-32
Waveform	9-1
Wavelength (band).	See also Frequency 2-1, 27, 33, 42, 62, 110 to 120 F. or T. 2-2, 28, 29, 31, 77 to 82 F. or T. 6-58, 64 9-2
Wax	13-26 F. or T. 13-12, 13
W/D index	See Oxford index
Weakness	7-83 14-35, 38
Weather, flying	7-90
Webbing	See Net seat and Belt
Weber-Fechner Law	F. or T. 7-65
Weight	See also Load carriage F. or T. 6-4, 16, 17, 44, 58, 64, 124, 127 (cont)

Weight (cont) 7-16, 115, 116, 125, 177 to 190
F. or T. 7-63, 65, 70 to 73
10-5, 15, 25, 26, 32, 36, 42 to 46
F. or T. 10-2 to 4, 14, 33
13-5 to 7, 17
F. or T. 13-1, 3 to 14
14-3 to 8, 16 to 18, 34 to 42
F. or T. 14-1, 2 to 8, 11, 13, 18, 21
16-2, 16, 21, 26, 54, 55
F. or T. 16-2 to 6, 9 to 12, 16, 17, 23

Weight, body 5-8, 9
8-5, 17, 21, 51
15-1, 3, 9, 11, 12

Weight loss 9-49

Weight penalties 11-20 to 39
F. or T. 11-10 to 16

Weightlessness See Zero gravity

Welding 9-57

Wet bulb-globe temperature index (WBGT). 6-16, 95
F. or T. 6-92

Wet bulb temperature F. or T. 6-7, 8, 12, 59, 76, 81, 85, 86, 122

Wet suit F. or T. 6-104, 105

Wetted area F. or T. 6-1, 4

Wetted fraction. 6-33, 37 to 40
F. or T. 6-1, 35 to 37, 68, 74

Wheel 7-48
F. or T. 7-27
8-83
F. or T. 8-32
F. or T. 16-20

Whiplash. 7-197

Whisper F. or T. 9-10

Whistle F. or T. 8-39

White, astronaut F. or T. 7-63

White noise See Jet noise

White-out 2-28

WHO F. or T. 15-14, 16

Whole body effect See Total body effect

Whole body exposure 3-45, 46, 48, 53, 55, 56
82, 83, 89
F. or T. 3-36 to 39, 55, 61

Wicking effect 6-90
F. or T. 6-4

Width 16-49
F. or T. 16-2 to 4, 10

Wind See also specific form
7-212
9-10, 11

Wind speed See also Velocity, gas
 11-3
 Wind tunnel 7-168
 F. or T. 7-69
 9-7, 52, 55
 F. or T. 9-5
 Windchill index 6-18, 113, 116 to 121
 F. or T. 6-99, 100, 102,
 105, 106, 108, 109, 112
 Window 2-78, 94
 F. or T. 2-61
 Wing F. or T. 8-32
 Winter 6-12, 107 to 127
 F. or T. 6-79 to 113
 F. or T. 16-9
 Wire 2-19
 Withdrawal, CO₂ 10-70, 71
 Wobble 7-110
 Woman 6-15
 F. or T. 6-10
 Wood 10-60
 F. or T. 10-44, 45
 Wool 6-125
 F. or T. 6-45, 95, 101
 Word 9-21, 24, 30, 53 to 55
 F. or T. 9-25 to 27, 29
 Word separation 7-49
 Work See also Exercise
 2-6
 F. or T. 2-2
 6-15, 51, 52, 62, 81, 98
 F. or T. 6-1, 2, 4, 8, 27,
 43, 49, 50, 60, 73, 75,
 80, 81, 87, 101
 8-58
 F. or T. 8-36
 Work capacity F. or T. 11-8
 Work efficiency See also Performance
 9-49, 59
 16-1, 26, 48, 74, 76, 86 to
 96
 F. or T. 16-28
 Work load 16-86, 87
 Work-rest-sleep-cycle See also Pacing, work
 10-40, 41, 65, 69, 70, 75
 F. or T. 10-31, 32
 16-26, 36, 74, 79 to 96
 F. or T. 16-27 to 30

Work space 7-133 to 158, 166 to 176
 16-1 to 79
 F. or T. 16-8

Work technique See also Performance
 7-127, 133 to 169, 172 to 176
 F. or T. 7-63, 65, 67, 70

Wound (ballistic) 7-212
 F. or T. 7-94

Wrist 7-48
 8-78
 12-30
 16-38, 49
 F. or T. 16-4 to 7, 11 to 15,
 19 to 21, 23

Wrist seal 12-27
 F. or T. 12-19

Writing 8-78
 F. or T. 16-8

X

X-ray 1-15, 16
 3-4, 29, 30, 48, 52, 53, 59,
 60, 68, 69, 74, 81, 85,
 86, 88
 F. or T. 3-1, 2, 4, 17, 46
 to 51, 56, 57, 63
 8-8
 F. or T. 11-8

Xenon 3-18
 F. or T. 3-15
 11-8
 F. or T. 11-1, 2, 5
 12-2
 F. or T. 12-18

Xiphoid F. or T. 16-4

Y

Yaw 2-104
 16-38, 43
 F. or T. 16-14

Yaw, spin or axis See also R
 7-4, 59, 62, 63, 93 to 96
 F. or T. 7-1, 28, 29, 37,
 39, 40, 48, 69, 87

Yawning	7-82
Young's modulus	F. or T. 7-74
	8-22, 32
Yugarov	7-131, 132

Z

Zeitgeber	16-81, 86, 89
Zero gravity	2-69 to 72, 120
	3-80
	F. or T. 3-65
	6-25, 32, 48, 49, 95
	F. or T. 6-4
	7-1, 16, 44, 56, 90, 94
	96, 105, 110 to 176
	F. or T. 7-1, 24, 64, 65, 68
	8-5, 89
	10-1, 25 to 36, 55, 65
	F. or T. 10-20
	11-25
	F. or T. 11-16
	13-85 to 91
	F. or T. 13-23
	14-14, 38
	F. or T. 14-78
	15-11, 12
	16-1, 3, 16, 43 to 64, 83 to
	85
	F. or T. 16-6, 18 to 22
Zodiacal light	F. or T. 2-6, 8